TWIN DISC
INCORPORATED

Service Manual

Marine Transmission

Components:
MG-6449RV

Document Number: 1021629

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Marine Transmission Service Manual

TWIN DISC, INCORPORATED
EXCLUSIVE LIMITED WARRANTY
MARINE PLEASURE CRAFT

A. Twin Disc, Incorporated warrants all assembled products and parts, (except component products or parts on which written warranties issued by the respective manufacturers thereof are furnished to the original customer, as to which Twin Disc, Incorporated makes no warranty and assumes no liability) against defective materials or workmanship *for a period of thirty-six (36) months from the date of original shipment by Twin Disc, Incorporated to the original customer, but not to exceed twenty-four (24) months of service, whichever occurs first.* **This is the only warranty made by Twin Disc, Incorporated and is in lieu of any and all other warranties, express or implied, including the warranties of merchantability or fitness for a particular purpose and no other warranties are implied or intended to be given by Twin Disc, Incorporated.** This warranty applies only to private, non-commercial (non-revenue earning) marine pleasure craft applications delivered by Twin Disc, Incorporated to the original customer on or after May 1, 1995.

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B. **The exclusive remedy provided by Twin Disc, Incorporated whether arising out of warranty within the applicable warranty period as specified, or otherwise (including tort liability), shall at the sole option of Twin Disc, Incorporated be either the repair or replacement of any Twin Disc, Incorporated part or product found by Twin Disc, Incorporated to be defective. For all models except MG340 and MG360 this include the labor to perform that work and to remove and reinstall (or equivalent credit). In this context, labor is defined as the flat rate labor hours established by Twin Disc, Incorporated in the published Twin Disc Flat Rate Schedule, required to remove, disassemble, inspect, repair, reassemble, reinstall and test the Twin Disc, Incorporated product only. Authorized reasonable travel and living expenses will be considered for payment in all model except MG340 and MG360. Under no circumstances, including a failure of the exclusive remedy, shall Twin Disc, Incorporated be liable for economic loss, consequential, incidental or punitive damages.** The above warranty and remedy are subject to the following terms and conditions:

1. Complete parts or products upon request must be returned transportation prepaid and also the claims submitted to Twin Disc, Incorporated within sixty (60) days after completion of the in-warranty repair.
2. The warranty is void if, in the opinion of Twin Disc, Incorporated, the failure of the part or product resulted from abuse, neglect, improper maintenance or accident.
3. The warranty is void if any modifications are made to any product or part without the prior written consent of Twin Disc, Incorporated.
4. The warranty is void unless the product or part is properly transported, stored and cared for from the date of shipment to the date placed in service.
5. The warranty is void unless the product or part is properly installed and maintained within the rated capacity of the product or part with installations properly engineered and in accordance with the practices, methods and instructions approved or provided by Twin Disc, Incorporated.
6. The warranty is void unless all required replacement parts or products are of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Replacement parts or products not of Twin Disc origin are not warranted by Twin Disc, Incorporated.

C. As consideration for this warranty, the original customer and subsequent purchaser agree to indemnify and hold Twin Disc, Incorporated harmless from and against all and any loss, liability, damages or expenses for injury to persons or property, including without limitation, the original customer*s and subsequent purchaser*s employees and property, due to their acts or omissions or the acts or omissions of their agents, and employees in the installation, transportation, maintenance, use and operation of said equipment.

D. Only a Twin Disc, Incorporated authorized factory representative shall have authority to assume any cost or expense in the service, repair or replacement of any part or product within the warranty period, except when such cost or expense is authorized in advance in writing by Twin Disc, Incorporated.

E. Twin Disc, Incorporated reserves the right to improve the product through changes in design or materials without being obligated to incorporate such changes in products of prior manufacture. The original customer and subsequent purchasers will not use any such changes as evidence of insufficiency or inadequacy of prior designs or materials.

F. If failure occurs within the warranty period, and constitutes a breach of warranty, repair or replacement parts will be furnished on a no-charge basis and these parts will be covered by the remainder of the unexpired warranty which remains in effect on the complete unit.

TWIN DISC, INCORPORATED
FLAT RATE HOUR ALLOWANCE
MARINE PLEASURE CRAFT

(Hourly Labor Rates Must Be Acceptable to Twin Disc, Incorporated)

MODEL SERIES	R&R	UNIT REBUILD
MG340, MG360	0.0	0.0
MG502, MG5010, MG5011, MG5005A, MG5015A	10.0	8.0
MG506, MG5050, MG5061, MG5062, MG5055A	10.0	11.0
MG507, MG5081, MG5085, MG5090, MG5091	10.0	12.0
MG509, MG5111, MG5112, MG5114	10.0	17.0
MG514C, MG5141	10.0	25.0
MG5202, MG5203, MG5204, MG5222 MG5225	10.0	32.0
MG6000	10.0	32.0
MGN80, MGN232, MGN233, MGN272, MGN273, MGN332, MGN334, MGN335, MGN432, MGN433, MGN472, MGN493	10.0	32.0
PUMP - ALL MODELS EXCEPT MG340 & MG360	1.0	-
VALVE - ALL MODELS EXCEPT MG340 & MG360	1.0	.5

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Introduction

General Information

This publication provides service information for the Twin Disc MG-6449RV marine transmission. Specific engineering details and performance characteristics can be obtained from the Product Service Department of Twin Disc, Incorporated, Racine, Wisconsin, USA.

Operation and maintenance personnel responsible for this equipment should be familiar with this publication and have it at their disposal. A thorough understanding and application of the material in this manual will result in consistent performance from the unit and help reduce downtime.

Safety and General Precautions

General

All personnel servicing this equipment should employ safe operating practices. Twin Disc, Inc. will not be responsible for personal injury resulting from careless use of hand tools, lifting equipment, power tools, or unacceptable maintenance/ working practices.

Important Safety Notice

Proper installation, maintenance, and operation procedures must be followed due to the possible danger to person(s) or property from accidents that may result from the use of machinery. Twin Disc, Inc. will not be responsible for personal injury resulting from careless maintenance/working practices.

Inspect as necessary to assure safe operations under prevailing conditions. Proper guards and other safety devices that may be specified in safety codes should be provided. These devices are neither provided by, nor are they the responsibility of Twin Disc, Inc.

⚠ WARNING

Selecting NEUTRAL disengages transmission clutches but does not prevent propeller shaft rotation. If you require positive neutral (propeller shaft locked), a shaft brake or other shaft-locking device must be used.

⚠ WARNING

To prevent accidental starting of the engine when performing routine transmission maintenance, disconnect the battery cables from the battery and remove ignition key from the switch.

⚠ WARNING

Most Twin Disc products have provisions for attaching lifting bolts. The holes provided are always of adequate size and number to safely lift the Twin Disc product. These lifting points must not be used to lift the complete power unit. Lifting excessive loads at these points could cause failure at the lift point (or points) and result in damage or personal injury.

⚠ CAUTION

Select lifting eyebolts to obtain maximum thread engagement with bolt shoulder tight against housing. Bolts should be near but should not contact bottom of bolt hole.

Preventative Maintenance

Frequent reference to the information provided in the Marine Transmission Owner's Manual, 1016313, regarding daily operation and limitations of this equipment will assist in obtaining trouble-free operation. Schedules are provided for recommended maintenance of the equipment.

Towing

⚠ WARNING

Under the conditions described below, the propeller shaft must be locked in place to prevent backdriving, or an optional trailing pump must be added. Failure to do this can damage the marine transmission due to the lack of component lubrication.

Backdriving (also called windmilling) occurs when an engine is shut down and the propeller shaft is being driven by the flow of water across the propeller, which, in turn, rotates the components in the marine transmission. During backdriving conditions, the transmission does not receive proper lubrication.

Conditions where backdriving may occur:

- ❑ Vessel is being towed.
- ❑ One or more engines on a multiple-transmission vessel are shut down while under way.
- ❑ Sailboat under sail with auxiliary engine shut down.
- ❑ Vessel tied up or docked in a heavy current.

The following solutions are applicable for all MG-6449RV transmissions if any of the above conditions are present:

- ❑ Lock the propeller shaft to prevent rotation.
- ❑ Add an optional trailing oil pump into the lubrication circuit.

Refer to the hydraulic system prints for more details on the optional trailing pump specifications for the applicable transmission, or contact your Twin Disc Authorized Distributor.

Ordering Parts and Obtaining Services

⚠ WARNING

All replacement parts or products (including hoses and fittings) must be of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Use of any other parts or products will void the warranty and may result in malfunction or accident, causing injury to personnel and/or serious damage to the equipment.

Ordering Service Parts

Renewal parts, service parts kits, optional equipment and product service assistance may be obtained from any authorized Twin Disc distributor or service dealer. Contact Twin Disc for the distributor or service dealer near you.

Note: Do not order parts from the part numbers on the cross-sectional drawings. These numbers may be referenced for part identification; however, they should be verified on the bill of material (BOM) before an order is placed. BOM numbers are stamped on the unit nameplate.

Twin Disc, having stipulated the bill of material number on the unit's nameplate, absolves itself of any responsibility resulting from any external, internal, or installation changes made in the field without the express written approval of Twin Disc. All returned parts, new or old, emanating from any of the above stated changes will not be accepted for credit. Furthermore, any equipment that has been subjected to such changes will not be covered by a Twin Disc warranty.

Source of Service Information

For the latest service information on Twin Disc products, contact any Twin Disc distributor or service dealer. This can be done on the Twin Disc corporate web site found at [http://www.twindisc.com]. Provide your model number, serial number and bill of material number to obtain information on your unit. If necessary, contact the Product Service Department, Twin Disc, Incorporated, Racine, Wisconsin 53405-3698, USA by e-mail at service@twindisc.com.

Warranty

Equipment written about in this manual has a limited warranty. For details of the warranty, refer to the warranty statement at the front of this manual or contact any Twin Disc Authorized Distributor, service dealer, or the Warranty Administration Department, Twin Disc, Inc., Racine, Wisconsin, U.S.A.

Description and Specifications

General

The 7-37431B, 738165B, and 738180 drawings identify the installation information for the MG-6449RV marine transmission. This unit is only available as a remote mounted unit that is driven by a driveline that attaches to the engine flywheel, usually through a flywheel mounted torsional coupling. The output shaft is angled downward from the input shaft by a 10 degree angle.

Nameplate

The nameplate identifies the model, bill of material (BOM) and the serial number of the unit. These numbers are necessary to identify the correct parts for your transmission.

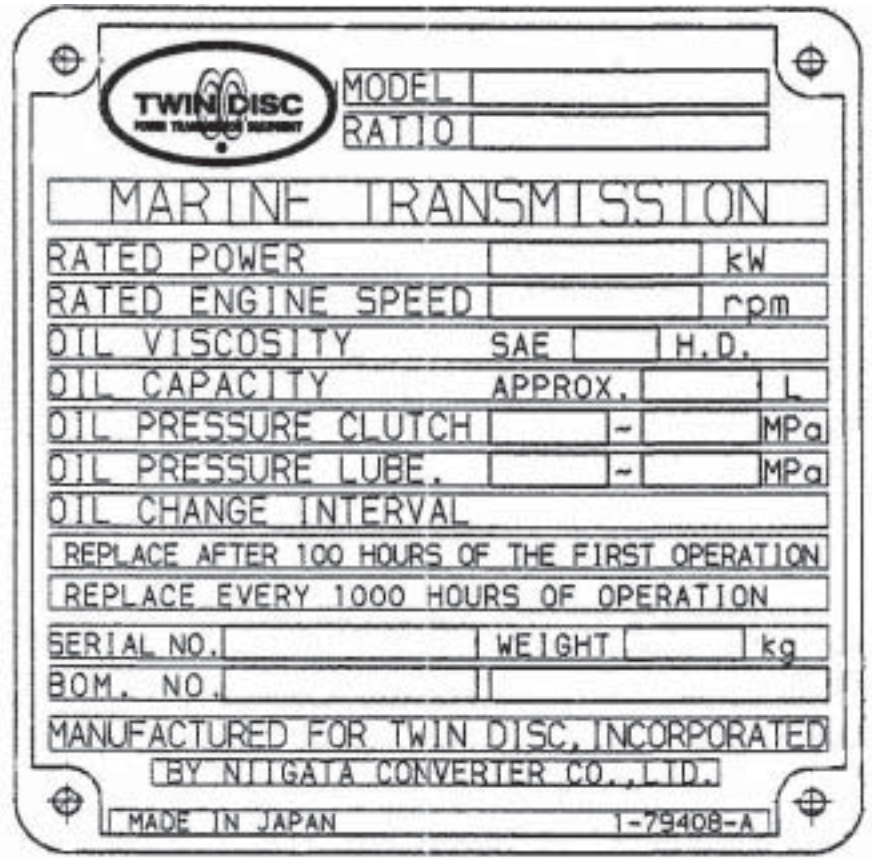

Figure 1. Nameplate for MG-6449RV Marine Transmission

Power Ratings

The MG-6449RV transmissions can be operated through either the primary shaft or secondary shaft at its full rated horsepower when driven by a standard right hand rotation engine (counterclockwise flywheel rotation when viewing rear of engine). This series of marine transmissions can be driven by a left hand rotation engine. Contact an authorized Twin Disc distributor for more information.

Transmission clutches are hydraulically applied using main oil pressure. All bearings, clutches and gears are lubricated and cooled with low-pressure oil.

Always reference the Bill of Materials (BOM) or Specification number when ordering service parts.

Construction Features

Housings

The MG-6449RV series transmission has a one piece main housing. A top cover, bottom cover, and manifold (sealed with silicone sealer) are bolted onto the housing. An end cover is located on the primary shaft, and a pump mount and pump are located on the secondary shaft, completing the housing enclosure.

Bearings

The primary and secondary clutch shafts are supported and located by tapered roller bearings. The pinions are supported on bushings and the end movement limited by thrust washers. Bearing clearances for each clutch shaft are set by using a single shim pack at the rear tapered roller bearing on each shaft. Tapered roller bearings and a spherical roller bearing support the output shaft and have bearing clearance adjusted by using shims at the rear bearing retainer.

Oil Pump and Drive

The oil pump is spline driven by the secondary clutch shaft.

Lubrication Features

The MG-6449RV transmission bearings and clutches on the primary and secondary shafts are lubricated through oil passages drilled in the shafts. The output shaft bearings, transfer gears, primary and secondary pinions and their bearings are gravity and splash lubricated.

Suction Screen

The marine transmission has a serviceable suction strainer located below the oil pump. The strainer is between the sump and oil pump in the hydraulic circuit. The strainer can be replaced if necessary.

Filter Assembly

A canister style filter is located between the oil pump outlet and the selector valve in the hydraulic circuit. The replacement element should be replaced at 1000 hour or six month intervals, whichever comes first. The replacement filter part number is 178363.

Gears

All gears are helical, carburized, hardened and skived or ground for smooth quiet operation. All gears are in constant mesh. The primary and secondary transfer gears/clutch spiders are shrunk-fit onto the primary and secondary shafts. Do not remove these gears during service. The output gear is mounted on a keyless taper.

Flexible Torsional Input Coupling

The purpose of the torsional coupling is to transmit power from the engine to the marine transmission through a flexible element that will:

- ❑ Dampen torsional vibrations
- ❑ Change the natural frequencies of a system to move critical frequencies out of the operating speed range
- ❑ Accommodate a certain amount of misalignment
- ❑ Absorb shock and reduce noise
- ❑ Minimize gear “rattle”

There is no flexible input coupling provided with this transmission. The engine supplier may provide a coupling as a part of the engine package.

Heat Exchanger

The heat exchanger is designed to maintain the oil in the hydraulic system of the marine transmission at the proper temperature by passing raw or fresh water through the heat exchanger. The heat exchanger is located in the transmission housing. Replaceable zincs for corrosion protection are located on the heat exchanger end caps.

Specifications

Maximum operating speed: 2500 rpm

Operating oil sump temperature: 65 - 70°C (149 - 158° F) when using SAE 40 oil

Oil type and viscosity: See data plate below

Oil capacity: 18 liters (4.8 gal)

Approximate Dry weight: 325 kg. (716 lbs.)

Oil pressure: See Table 1. Oil temperature to be in normal operating range.

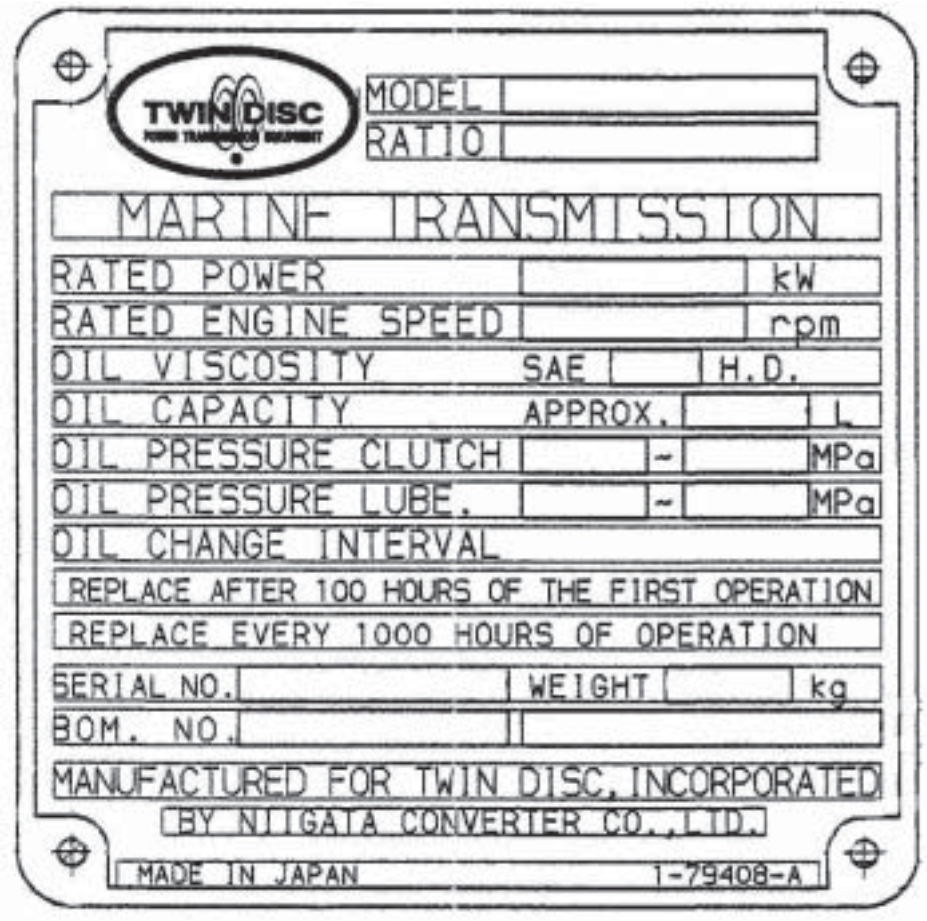

Figure 2. Oil Specification Data Plate

Table 1. 2551-2758 kPa (370-400 psi) Transmission Oil Pressure Specifications

Mechanical Valve - 2551 - 2758 kPa (370 - 400 psi) Springs									
Input Speed	Shift Position	Main Pressure at Valve Inlet		Primary Clutch Min.		Secondary Clutch Min.		Lube	
		kPa	psi	kPa	psi	kPa	psi	kPa	psi
Idle	Neutral	255-310	37-45	0	0	0	0	19 min	2.8 min
Idle	Primary	786-2758	114-400	786	114	0	0	19 min	2.8 min
Idle	Secondary	786-2758	114-400	0	0	786	114	19 min	2.8 min
Rated	Neutral	490-1179	71-171	0	0	0	0	193-690	28-100
Rated	Primary	2551-2758	370-400	2551	370	0	0	193-586	28-85
Rated	Secondary	2551-2758	370-400	0	0	2551	370	193-586	28-85

Note: It is required that primary and secondary clutches must be within 97 kPa (14 psi) of each other.

Optional Equipment

The following optional equipment for use with the model MG-6449 RV is available through the nearest authorized Twin Disc distributor.

Optional Trailing Pump

A trailing pump kit # 5-49402 is available that bolts onto the output end of the marine transmission. A drawing is included in the Engineering Drawings.

Power Take-off

A live Pump Mount power take-off and a hydraulically clutchable power take-off are available and mount on the rear of the transmission. They rotate at the same speed and direction as the engine.

Electric Control Valve

Electric control valve are standard with either 12 vdc or 24 vdc actuating solenoids.

Coupling Flange

A coupling companion flange is available.

Trolling Valve

A mechanical trolling valve is available for mounting on the electric control valve. The part number is 1019988.

Table 2. Bearing End Play Specifications

Transmission Primary and Secondary Shaft Tapered Roller Bearing Endplay		
Assembly No.	**Minimum**	**Maximum**
All	-0.05 mm (-0.002 in)	+0.05 mm (+0.002 in)
Transmission Output Shaft Bearing Endplay		
Assembly No.	**Minimum**	**Maximum**
All	0.00 mm (.000 in)	+0.05 mm (+0.002 in)

Note: A negative end play indicates a pre-load condition.

Table 3. Output Flange Runout Limits

Feature	Maximum allowable total indicator reading
Output flange face near O.D	0.10mm (.004 in)
Output flange pilot diameter	0.10mm (.004 in)
* This note applies to a continuous 270° arc if the pilot is negative in readings; otherwise it means all 360°	

Torque Values for Fasteners

Note: Lubricate all threads and bearing face with light oil film prior to assembly. Use SAE grade 5 and Property Class 8.8 torque value for all screws that are threaded into aluminum.

Table 4. Metric Coarse Thread Capscrews, Bolts, and Nuts

Thread Size	Property Class 8.8		Property Class 10.9		Property Class 12.9	
	lb-ft	Nm	lb-ft	Nm	lb-ft	Nm
M6	6.5 - 7.5	9 - 10	9 - 10	12 - 14	10 - 12	14 - 16
M8	16 - 18	21 - 25	23 - 26	31 - 35	25 - 29	34 - 40
M10	32 - 36	43 - 49	44 - 51	60 - 68	51 - 59	70 - 80
M12	55 - 63	74 - 86	77 - 88	104 - 120	89 - 103	121 - 139
M16	132 - 151	179 - 205	189 - 217	256 - 294	219 - 253	298 - 342
M20	257 - 295	348 - 400	364 - 418	493 - 567	429 - 493	581 - 669
M24	445 - 511	603 - 693	626 - 720	848 - 976	737 - 848	1000 - 1150
M30	714 - 820	987 - 1113	1235 - 1421	1674 - 1926	1475 - 1697	2000 - 2301

Table 5. Tapered Pipe Plugs (with thread lubricant)

Torque Values for Lubricated Pipe Plugs Recommended Torque in N-m (Lbf-ft)			
PT Size	**NPTF** Size	**Installed in Cast Iron or Steel**	**Installed in Aluminum**
1/16 - 28	1/16 - 27	11.5 ± 1.3 (8.5 ± 1.0)	7.5±0.9 (5.5±0.7)
1/8 - 28	1/8 - 27	14.2 ± 1.8 (10.5 ± 1.3)	8.8 ± 1.1 (6.5 ± 0.8)
1/4 - 19	1/4 - 18	34 ± 4 (25 ± 3)	22 ± 3 (16 ± 2)
3/8 - 19	3/8 - 18	37 ± 4 (27 ± 3)	23 ± 3 (17 ± 2)
1/2 - 14	1/2 - 14	68 ± 8 (50 ± 6)	41 ± 5 (30 ± 4)
3/4 - 14	3/4 - 14	73 ± 10 (54 ± 7)	46 ± 5 (34 ± 4)
1 - 11	1 - 11-1/2	109 ± 13 (80 ± 10)	68 ± 8 (50 ± 6)
1-1/4 - 11	1-1/4 - 11-1/2	115 ± 13 (85 ± 10)	75 ± 9 (55 ± 7)
1-1/2 - 11	1-1/2 - 11-1/2	115 ± 13 (85 ± 10)	75 ± 9 (55 ± 7)

Notes:

The lubricant is to be John Crane insoluble plastic lead seal No. 2 (or equivalent), or Loctite® No. 92 (or equivalent) and plugs are to be capable of removal without damage. Overtightening may cause initial leakage, plus potential removal damage.

An option of a maximum of two full turns after finger tightening the plug may be used if required and if removal conditions are met.

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Table 6. Straight Threaded Tube Fittings, Hose Fittings, and O-ring Plugs

Nominal Thread Diameter	Nm + or - 5 %	lb-ft + or - 5 %	Nominal Thread Diameter	Nm + or - 5 %	lb-ft + or - 5 %
5/16	5	3.5	1 5/8	108	80
3/8	11.5	8.5	1 7/8	108	80
7/16	16	12	2 1/2	108	80
1/2	20	15	M10X1.0	12	9
9/16	24	18	M12X1.5	16	12
5/8	24	18	M14X1.5	20	15
11/16	34	25	M16X1.5	24	18
7/8	54	40	M18X1.5	34	25
1 1/16	75	55	M22X1.5	54	40
1 3/16	88	65	M27X2.0	75	55
1 1/4	88	65	M33X2.0	88	65
1 5/16	108	80	M42X2.0	108	80
1 3/8	108	80	M48X2.0	108	80

Table 7. Tubing Nuts

Torque Values for Tubing Nuts	
Nominal Tube Size	**Recommended Torque N-m (Lbf-ft)**
8 mm	39 (29)
10 mm	52 (38)
12 mm	62 (46)
15 mm	103 (76)
21.7 mm	118 (87)

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Table 8. Banjo Fittings and Sealing Plugs with Copper Washers

Torque Values for Banjo Fittings & Sealing Plugs with Copper Washers	
Thread Size	**Recommended Torque N-m (Lbf-ft)**
M14 x 1.5	64 (47)
M16 x 1.5	83 (61)
M24 x 1.5	186 (137)

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Clutch Plate Wear Limits

Clutch steel plates:

Minimum thickness: 2.10 mm (0.083 inch).

Clutch friction plates:

Minimum thickness: 3.15 mm (0.124 inch).

Operation

General

The control valve obtains primary, neutral and secondary positions. When these positions are selected, the control valve directs high-pressure oil through internal passages to operate the clutches. The pressure-rate control piston within the control valve assembly provides a rapid, smooth, oil pressure increase in the hydraulic system during clutch engagement.

Hydraulic System with Electric Control Valve

The oil pump draws oil through the strainer from the oil sump and discharges it through the oil filter. Filtered oil enters the control valve through the inlet port. The incoming oil forces the pressure regulator piston against the springs to open the path to the lubrication circuit. Oil not used for clutch engagement flows past the regulator piston to become lubrication oil. Lubrication oil flows through the heat exchanger to the lubrication oil circuit in the transmission to lubricate and cool the clutches and bearings. There is a lubrication oil pressure relief valve to limit maximum lubrication oil pressure to approximately 690 kPa (100 psi).

In Neutral, the inlet port of both clutches is connected to the atmosphere. Since the area behind the clutch pistons is open to sump, the clutches are disengaged. Oil is distributed through the lubrication system. The area between the pressure regulating piston and the rate-of-rise piston is connected to sump at all times to prevent any leaking oil from affecting the pressure regulation.

The pressure in the rate-of-rise chamber is controlled by a ball that is spring loaded against the orifice plate. The passage behind the ball and spring is connected to the sump (atmosphere) in Neutral and to main pressure when either clutch is engaged. A shuttle ball, connected to both clutch pressure ports, permits pressurizing this passage with oil from the engaged clutch without allowing oil to flow to the disengaged clutch.

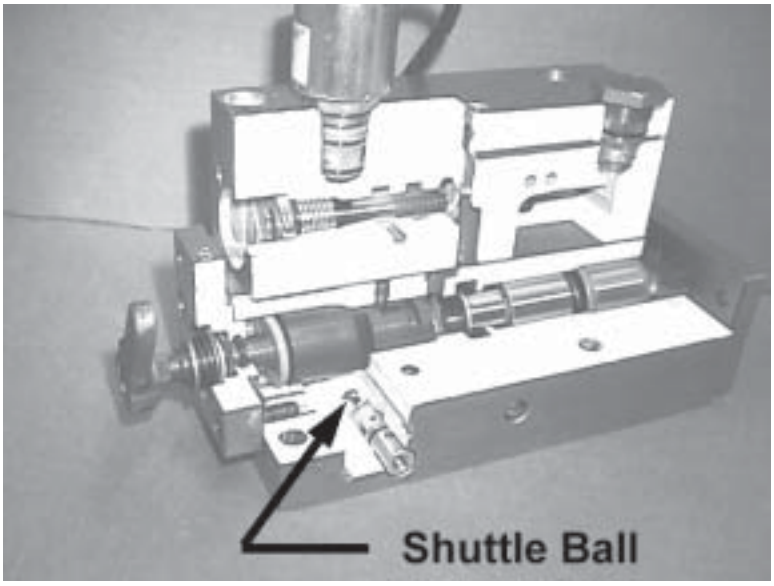


Figure 3. Location of Shuttle Ball

The electric control valve can be used in a manual override mode in the event of an electrical power failure.

When the control valve is energized or shifted to engage either clutch, the valve directs main pressure to engage the selected clutch pack. Oil is also directed to move the rate-of-rise piston, compressing the pressure regulator springs. This progressively increases the clutch engaging pressure causing the clutches to engage at a controlled rate.

The control valve allows only one clutch to be engaged at a time, and the oil from the disengaged clutch is vented to sump (atmospheric pressure). The clutch return springs move the disengaged clutch's piston to the disengaged position minimizing clutch plate drag.

Control Valve Assembly in Neutral

Some of the main pressure oil from the oil inlet chamber flows through a passage to the orifice in the orifice plate. The small flow of oil through this orifice fills and begins to pressurize the rate-of-rise chamber.

Both clutches are connected to sump when the control valve is in Neutral. Since there is no pressure acting on the shuttle ball from either clutch, the passage behind the ball and spring regulator is also connected to sump. This allows the oil pressure in the rate-of-rise chamber to be regulated by the ball and spring, since the overage oil can flow to sump. The oil pressure in the rate-of-rise chamber acting on the rate-of-rise piston causes it to stroke over partially, which compresses the pressure regulating springs.

This additional spring compression further resists the movement of the pressure regulating piston, resulting in a force balance between the area at the pressure regulator, the springs, and the area behind the rate-of-rise piston. Neutral main pressure of approximately 40 psi is maintained by relieving excess oil behind the rate-of rise piston through the ball and spring regulator.

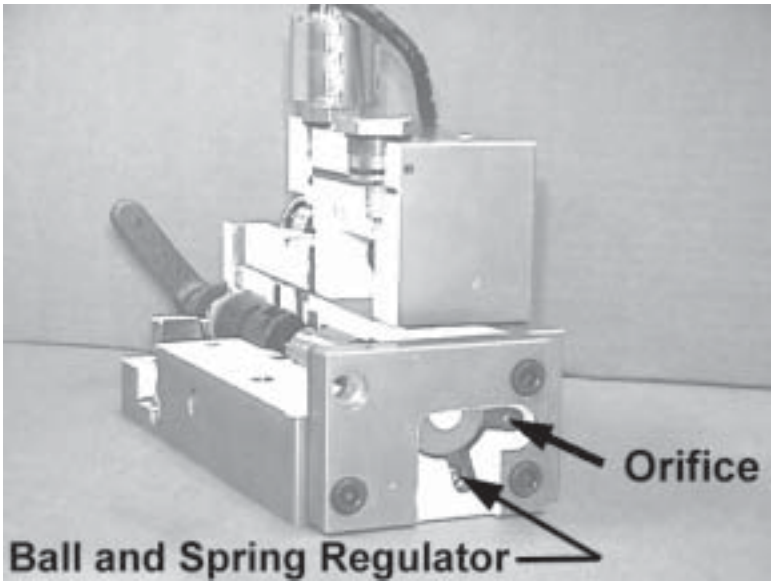


Figure 4. Neutral Regulator and Rate of Rise Orifice

Control Valve Assembly in Primary or Secondary

Pressurized oil is directed to one of the transmission's clutches to engage it. The pressurized oil in the clutch port of the engaged clutch acts on the shuttle ball, sealing off the passage to the opposite clutch. The pressurized oil also forces the ball of the ball and spring regulator against its seat on the orifice plate, stopping the flow of oil from the rate-of-rise chamber to sump. Since oil continues to flow into the rate-of-rise chamber through the orifice, the oil pressure in the rate-of-rise chamber increases. This increased oil pressure forces the rate-of-rise piston to stroke over to its stop in the valve body, compressing the pressure regulating springs even more.

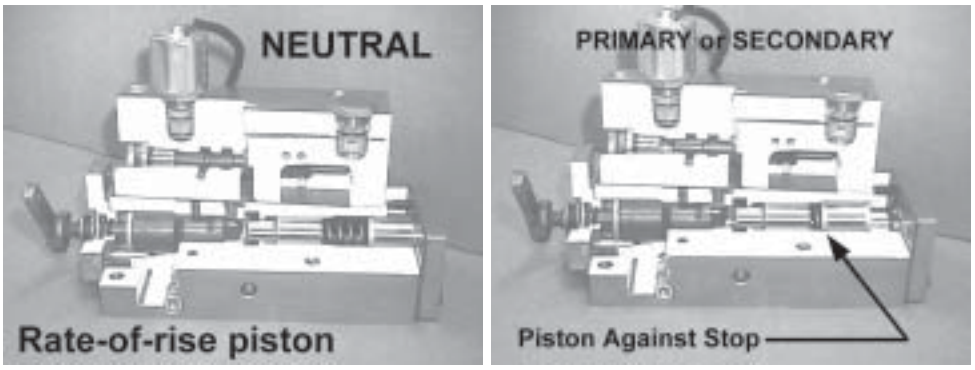


Figure 5. Rate of Rise Piston in Neutral (left) and Rate of Rise Piston with Clutch Engaged (right)

The travel rate of the rate-of-rise piston (and resulting pressure rate-of-rise) is controlled by the orifice size, regulator spring stiffness and the final main pressure after completion of the rate-of-rise cycle. Neutral main pressure controls the start time of the rate-of-rise cycle. When the rate-of-rise piston is against the stop (pressure regulating springs are compressed the most), the main oil pressure reaches approximately 370 psi.

When the control valve is shifted to Neutral, the clutch that was engaged is vented to sump within the valve. As a result, the passage behind the ball and spring regulator is vented to sump and induces a high differential pressure between the rate-of-rise chamber and the passage behind the ball and spring. Since the pressure in the rate-of-rise chamber is much greater than the pressure it is to be regulated at, the ball unseats from the orifice plate, allowing main oil pressure to return to the neutral pressure level rapidly and again be regulated by the ball and spring regulator. The ball returns to the pressure regulating position once the spring force is equal to force induced by the pressure at the rate-of-rise piston.

Electric Operation

The transmission normally operates with the control valve in the electric mode. Two spools, each controlled by a solenoid operated pilot valve, control clutch engagement. When a solenoid is energized, it opens the pilot valve and allows main pressure oil to flow to the end of the spool. The pressure acting on the end of the spool overcomes the return spring at the opposite end, causing the spool to stroke over and connect the clutch passage with main pressure passage.

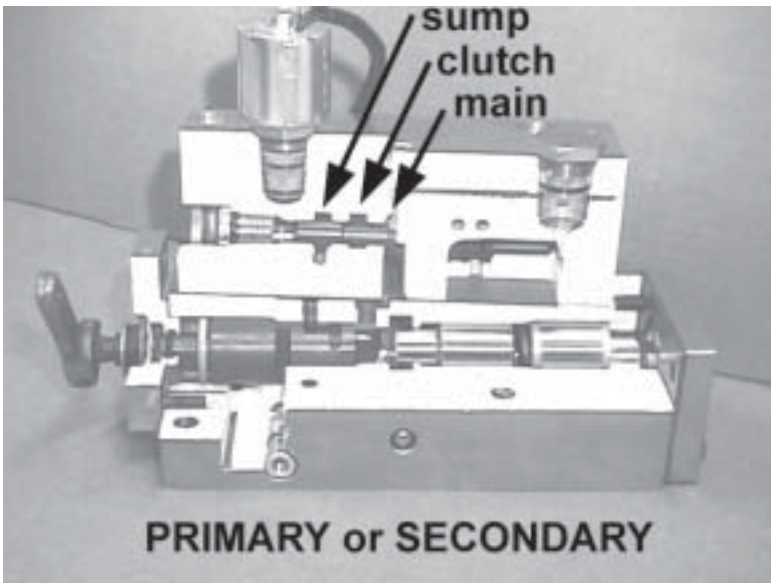


Figure 6. Pilot Spool Passages

Main pressure oil flows from the spools above to the clutch passages of the transmission below via connecting slots in the manual override stem. These connecting slots are aligned with passages in the valve body when the valve is in the electric mode.

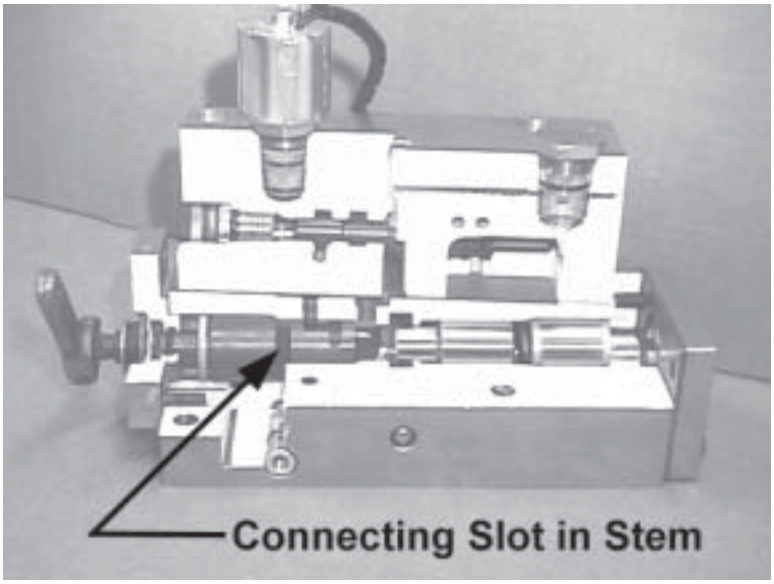


Figure 7. Flow Path in Override Spool

Main pressure from the energized solenoid operated pilot valve also acts on a pin on the return spring side of the opposite spool to ensure the opposite spool is connecting its clutch to sump. The clutch engagement cycle is outlined in the previous section.

Hydraulic Lock Feature (some models)

Some control valve models have a hydraulic lock feature, and are identifiable by a third solenoid operated pilot valve. This feature keeps the engaged clutch pressurized as long as the engine remains running, should electrical power fail or malfunction occur while the clutch is engaged. The hydraulic lock is accomplished by allowing pressurized oil (from the pressurized clutch passage) to flow inside the spool. Oil pressure inside the spool forces the dowel pin against the O-ring plug.

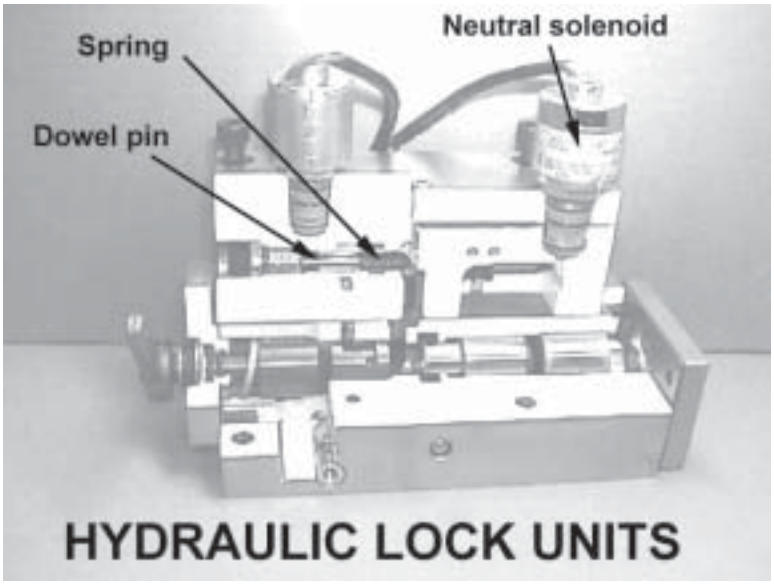


Figure 8. Hydraulic Lock Units

The resulting reaction is a force on the spool that overcomes the spool's return spring force. Should the solenoid become de-energized while the spool has its clutch pressurized, oil pressure will keep the spool in that position. This keeps the transmission in gear as long as the engine is running.

The hydraulic lock is disabled when either the engine is stopped, or the neutral solenoid is energized. When the neutral solenoid is energized, it sends pressurized oil to the dowel pins at the return spring end of each spool.

Since the dowel pin used at the return spring side of the spool is larger in diameter than the dowel pin inside the spool, the hydraulic force acting on the larger pin forces the spool to connect the clutch passage to sump with assistance from the return spring.

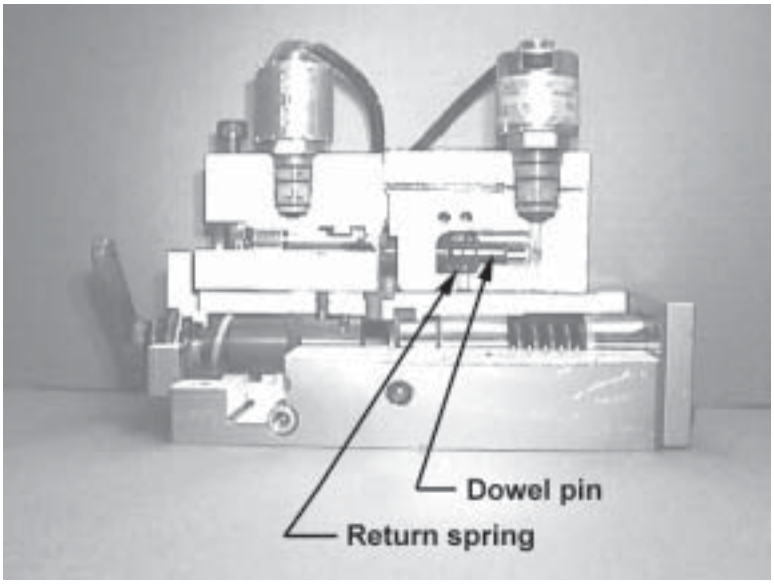


Figure 9. Neutral Solenoid Engaged

Manual Override Operation

The control valve has a manual override feature, which is a lever operated selector. When the manual override lever is rotated counterclockwise and pulled outwards, the upper portion of the valve is disabled because the connecting slots in the manual override stem are no longer aligned with the oil passages in the valve body. Oil pressure from the solenoid operated pilot valve controlled spools cannot reach the clutch pressure passages in the transmission. The main oil pressure regulator, shuttle ball, neutral pressure regulator, and rate-of-rise functions remain exactly the same as when the valve is in the electric mode. In the manual override position, shifting is controlled by rotating the lever on the manual override stem.

In the Neutral position, both clutches are vented to sump by two pockets in the stem.

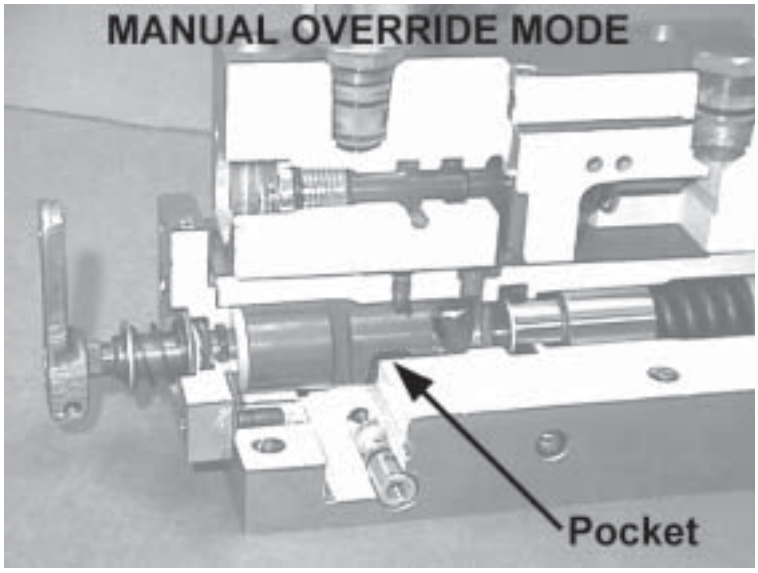


Figure 10. Stem Pocket or Passage

Main pressure oil can flow through the hole in the end of the stem to a narrow slot between the two pockets. This slot does not connect to any other passages when the stem is in the Neutral position.

When the lever and stem are rotated to engage either the primary or secondary clutch, main pressure oil flows through the slot in the stem to the appropriate clutch pressure port. The opposite clutch port passage remains connected to sump by the same pocket in the stem as when the stem was in the Neutral position. When the stem is rotated back to the Neutral position, the main pressure oil slot in the stem is no longer aligned with either clutch port. Both clutches are again vented to sump by the two pockets in the stem.

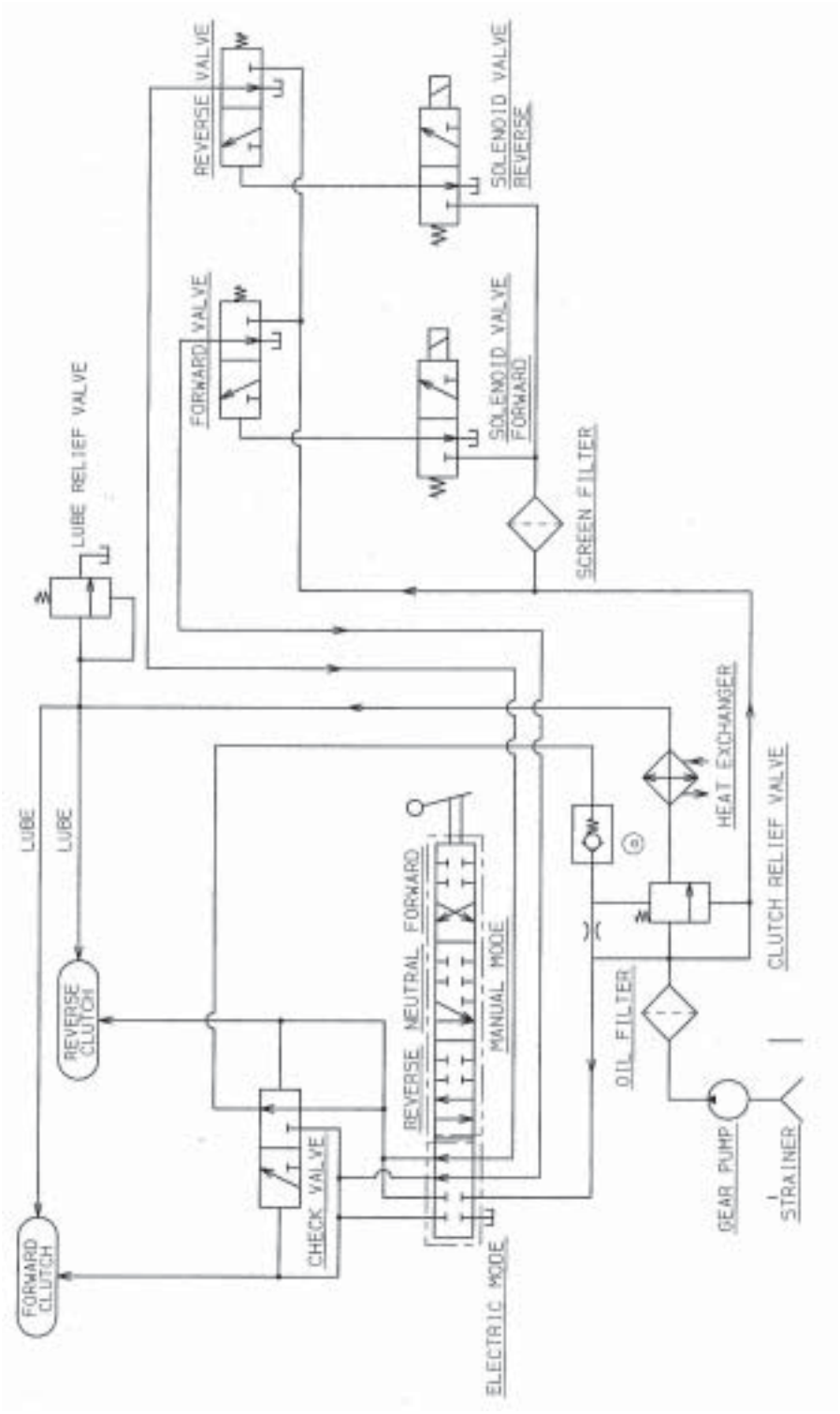


Figure 11. Hydraulic Schematic (electric control valve)

General Overview of GP Control Valve with Electronic Interface

The General Purpose (GP) control valve is a hydraulic valve assembly for use with Twin Disc Marine Transmissions, that may include an integral electronic interface control module. The valve assembly contains current controlled proportional cartridges.

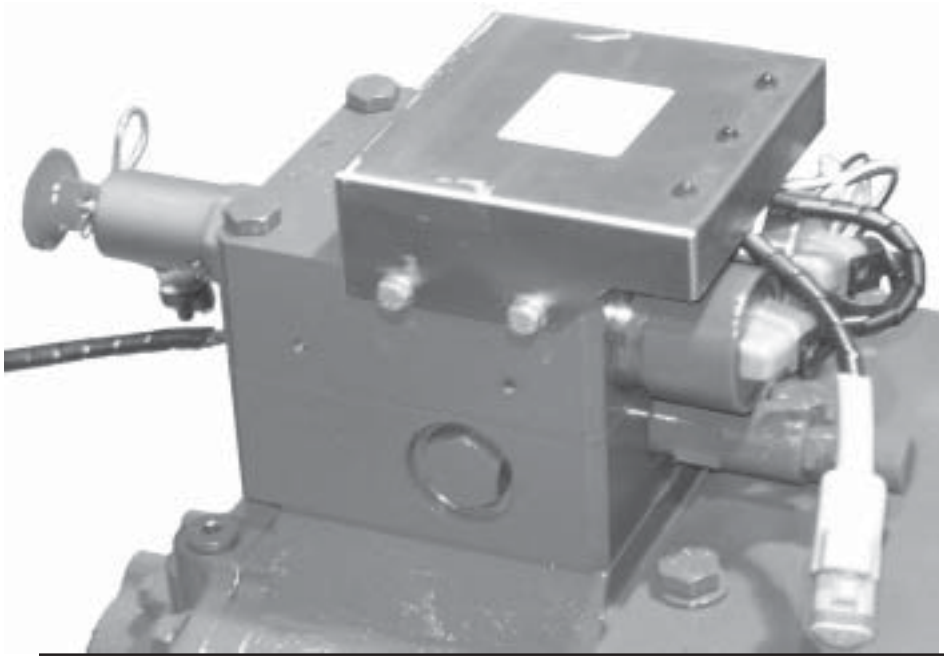


Figure 12. GP Valve Assembly mounted on Marine Transmission.

GP Control Valve Hydraulic Portion

The hydraulic portion of the GP Control Valve is made up of two blocks, a lower main regulator valve body, and an upper valve body. The upper valve body contains two electrically actuated proportional valves, and a manual direction control cartridge valve. The lower valve body contains the hydraulic pressure regulating valve and a temperature sensor if the application requires it. There are two different versions of the lower valve assembly. The hydraulic pressure regulating valve in earlier versions (Assembly 1020729) consist of two cartridge assemblies, a pilot relief cartridge assembly and a main spool cartridge assembly. The hydraulic pressure regulating valve in later versions (Assembly 1021658) is not a cartridge assembly, but is comprised of a spring and spool, with an adjustment cover. The regulating valve body contains a ball check valve assembly in parallel with an orifice with a filter that provides rapid fill and damping for the rear cavity of the regulator valve. A kit is available to upgrade the earlier version to the later version. A temperature sensor is housed in the main regulator valve body on some applications. The manual direction control cartridge valve contains a switch that is closed when the valve is in the neutral position. Separate identical proportional cartridges are used for the primary and secondary clutch actuation. When the primary or secondary clutch is selected by the operator, the control valve directs high-pressure oil through internal passages to operate the clutches. The pressure-rate of rise (profile) is controlled electronically by the GP Control Valve Electronic Interface (Profile or E-Troll Module) to provide a rapid, smooth, oil pressure increase in the clutch hydraulic passages during engagement.

⚠CAUTION

The proportional valve coils are low resistance devices that are current driven. The use of an uncontrolled power source may supply too much current and damage the proportional valve.

Note: Installations with this valve must include an oil filter with the proper filtering characteristics. This valve requires a filtration level of 16 micron at an efficiency of 98% (beta ratio = 75) or better. Besides the valve's requirement on filtration, the filter must meet the requirements of the transmission (operating pressure, flow, etc.)

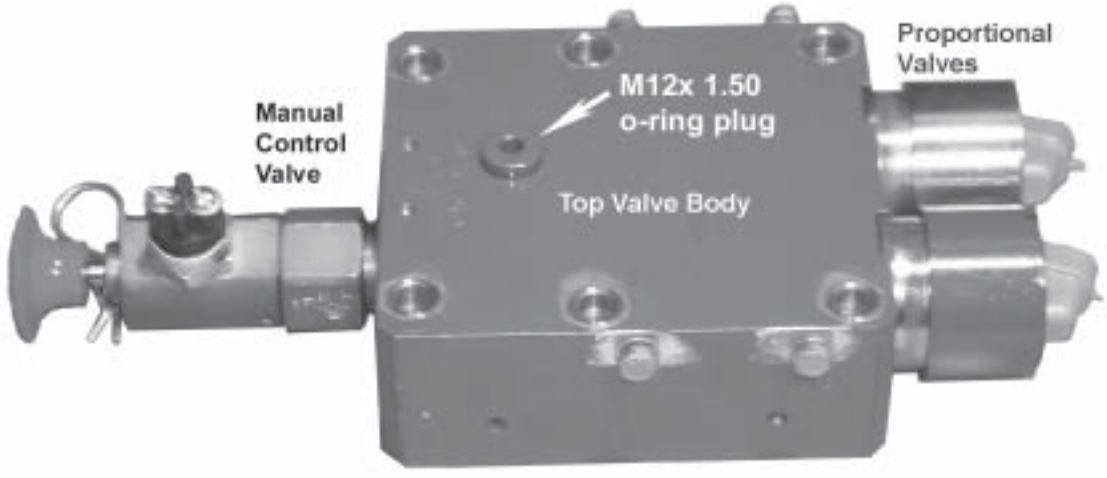


Figure 13. Top Hydraulic Valve Body Assembly

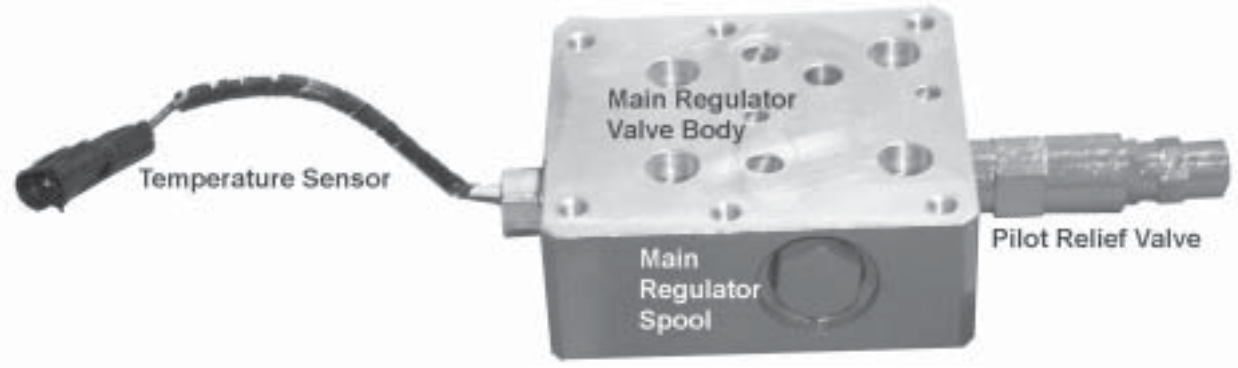


Figure 14. Main Regulator Hydraulic Valve Assembly (1020729)

Figure 15. Main Regulator Assembly (1021658)

GP Control Valve Electronic Control Interface (Profile or E-Troll Module)

Note: Some installations will consist of the hydraulic portion of this valve, and the Electronic Control Interface will be replaced by an appropriate electronic control system.

The electronic portion of the GP Control Valve fastens to the hydraulic portion of the GP Control Valve, and is located on the top surface. This module contains the electronic circuitry to control the proportional cartridges that are used to engage the clutches based on the commands from the operator. Clutch apply pressure rate of rise (profile) is factory set with the use of internal circuitry. The initial fill level is factory set with an adjustment screw that is embedded in the bottom surface of the Profile or E-Troll Module, and sealed. This can be field adjusted if necessary by authorized personnel with the proper instrumentation. There are two different types of control modules for the MG6449RV marine transmission, with and without the trolling (E-Troll) feature. All electrical wiring for the marine transmission system controls are routed through this interface module. The vessel battery power (12 vdc or 24 vdc) is supplied to the electronic interface only, and never directly to the hydraulic proportional valves. Two red led lights are used to identify the proportional cartridge valve that is energized, and a green led is used to identify when power is provided to energize one of the clutches. Signals are provided to power a customer supplied relay to allow engine starting only when in neutral. A transmission oil temperature sensor is required for the MG6449RV marine transmission. Engine speed and Propeller speed sensors are required for transmissions with E-Troll. The following figures show the various versions of Electronic Profile or E-Troll Module.

WARNING

Do not connect valve coils directly to battery power supply voltage. Use an approved Twin Disc Control System.

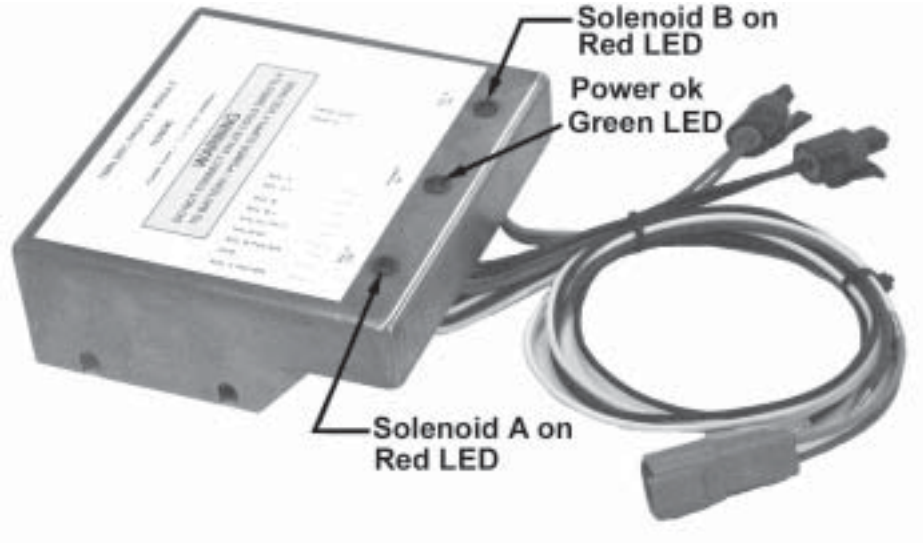


Figure 16. Electronic Profile Module

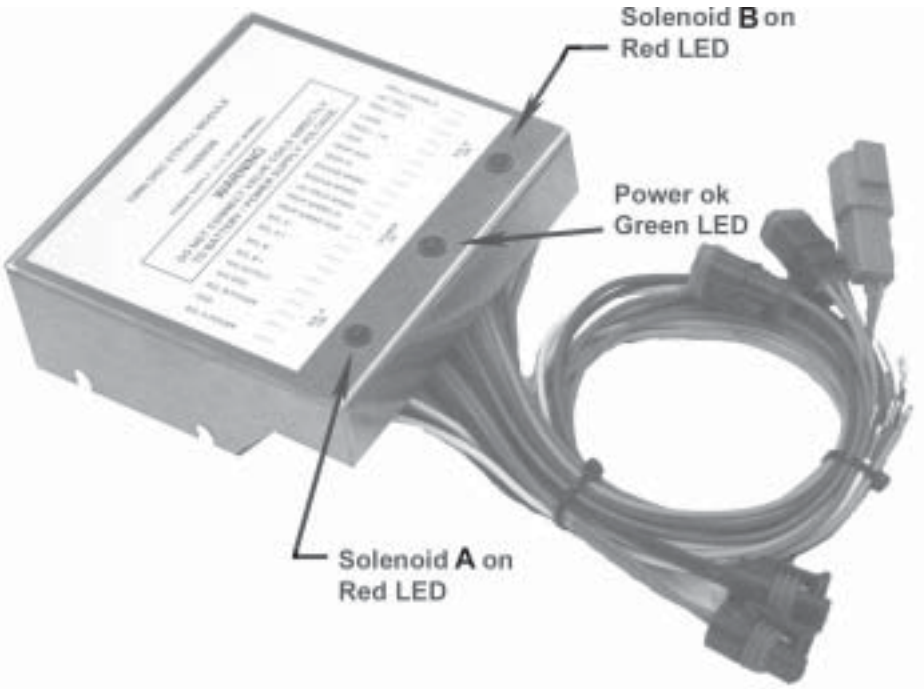


Figure 17. Electronic E-Troll Module

Hydraulic System with GP Control Valve

The oil pump draws oil through the strainer from the oil sump and discharges it through the heat exchanger to the oil filter. Filtered oil enters the control valve through the inlet port. The incoming oil (Assembly 1020729) is supplied to the main pressure regulating relief pilot cartridge and the main regulating valve cartridge, satisfying the main pressure requirements of the transmission, cascading all remaining oil flow into the lubrication circuit. The incoming oil (Assembly 1021658) is supplied to the main pressure regulating valve and is supplied in parallel paths through a ball check valve and an orifice with filter to quickly regulate, and dampen pressure oscillations, satisfying the main pressure requirements of the transmission, cascading all remaining oil flow into the lubrication circuit. Oil not used for clutch engagement flows past the regulator piston to become lubrication oil. Lubrication oil flows through the lubrication oil circuit in the transmission to lubricate and cool the clutches and bearings.

Main pressure is supplied to the inlet of each proportional valve, and to the inlet of the manual direction control valve. In Neutral, the inlet port of both clutches is connected to the sump. Since the area behind the clutch pistons is open to sump, the clutches are disengaged.

When one of the clutches is commanded to engage, the proportional valve directs main pressure to engage the selected clutch pack. The rate-of-rise is controlled electronically and prefills the engaging clutch at a predetermined level, and then increases to full pressure, following a predetermined timing sequence. The initial prefill level is factory adjustable by means of an adjustment screw embedded in the bottom surface of the electronic interface. Field adjustment of this feature should never be attempted without special equipment and knowledge of its use to prevent serious mechanical damage to the marine transmission or vessel.

The electronic interface portion of the control valve allows only one proportional valve to be energized at a time, thus, only one clutch can be engaged at a time, and the oil from the disengaged clutch is vented to sump (atmospheric pressure). The clutch return springs move the disengaged clutch's piston to the disengaged position minimizing clutch plate drag.

Note: Installations with this valve must include an oil filter with the proper filtering characteristics. This valve requires a filtration level of 16 micron at an efficiency of 98% (beta ratio = 75) or better. Besides the valve's requirement on filtration, the filter must meet the requirements of the transmission (operating pressure, flow, etc.)

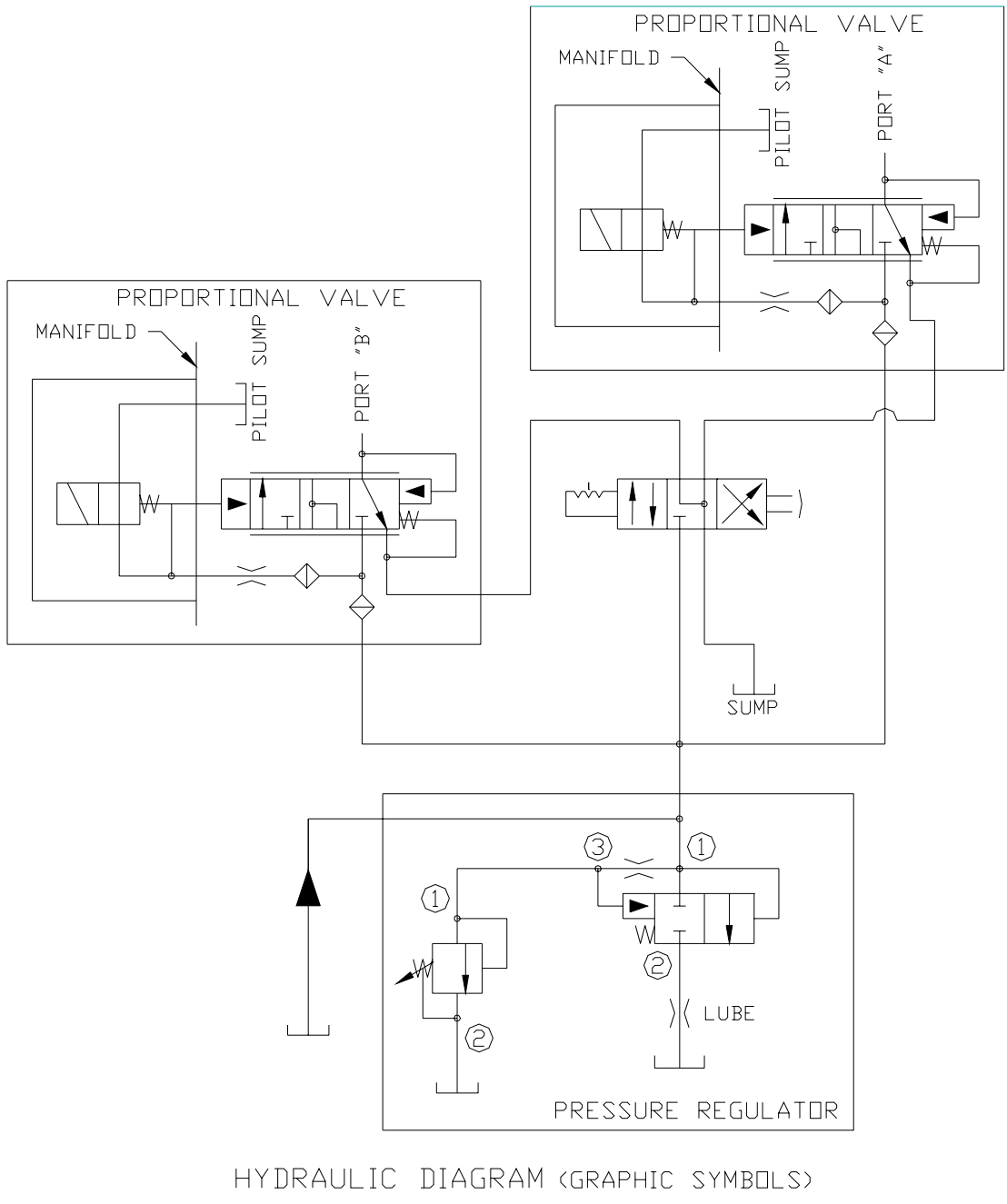


Figure 18. Hydraulic Schematic (GP control valve)- Assembly 1020729

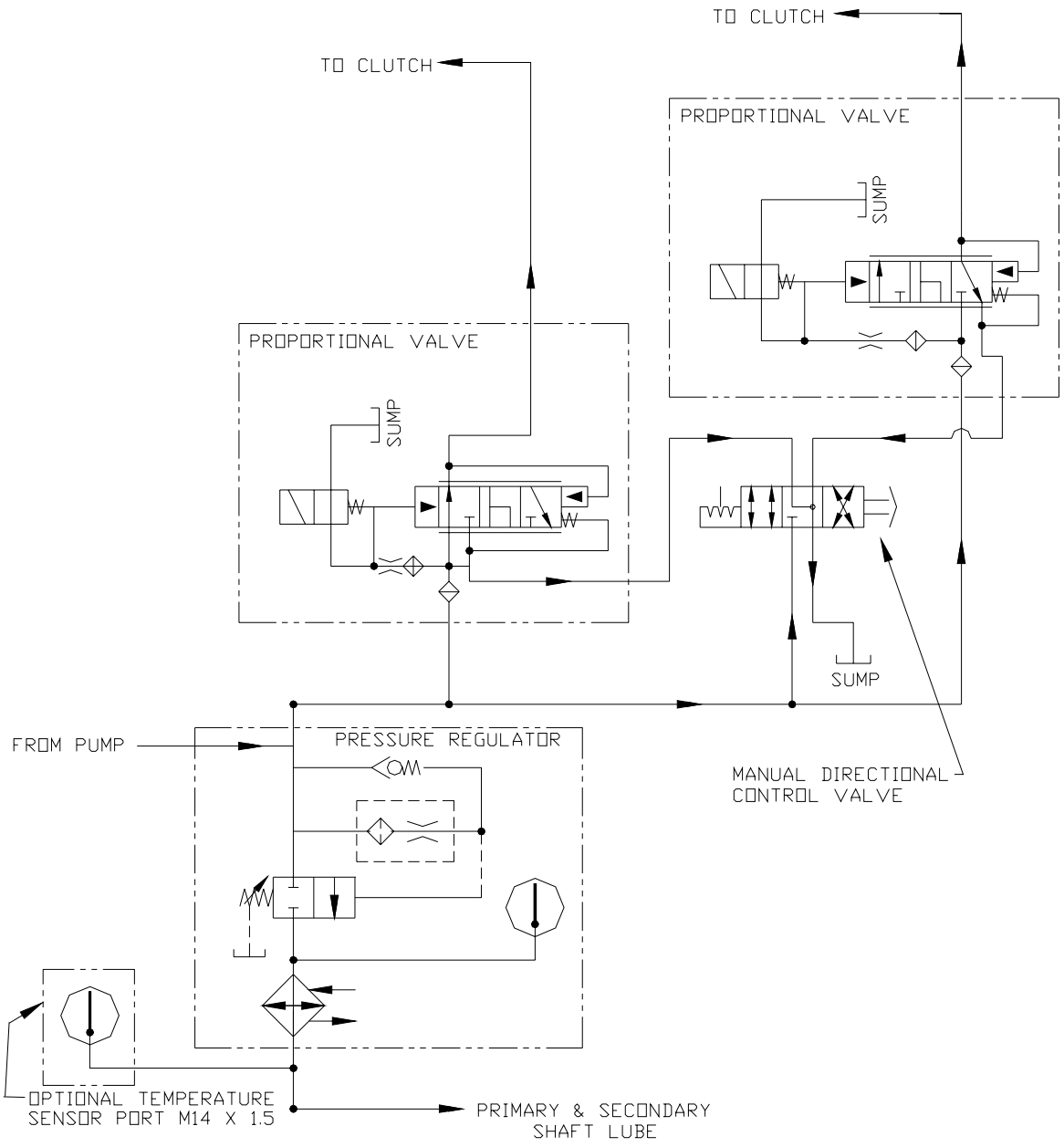


Figure 19. Hydraulic Schematic (GP control valve) -- Assy 1021658

Manual Direction Control Valve Operation

The manual direction control valve is locked in the NEUTRAL (center) position during normal operation. There are three possible positions of the manual direction control valve stem. If conditions exist that the operator wishes to manually operate the transmission for any reason, the operator can remove the locking pin from the direction control valve, and push the stem into the valve for engagement of clutch A, or pull it out of the valve for the engagement of clutch B. The manual direction control valve has an integral switch with contacts that are closed only when the manual direction control valve is in the NEUTRAL position. This switch must be wired such that the engine cannot be started while clutch A or clutch B is engaged.

CAUTION

Engagement of a clutch with the Manual Direction Control Valve should only be done with the engine at idle speed

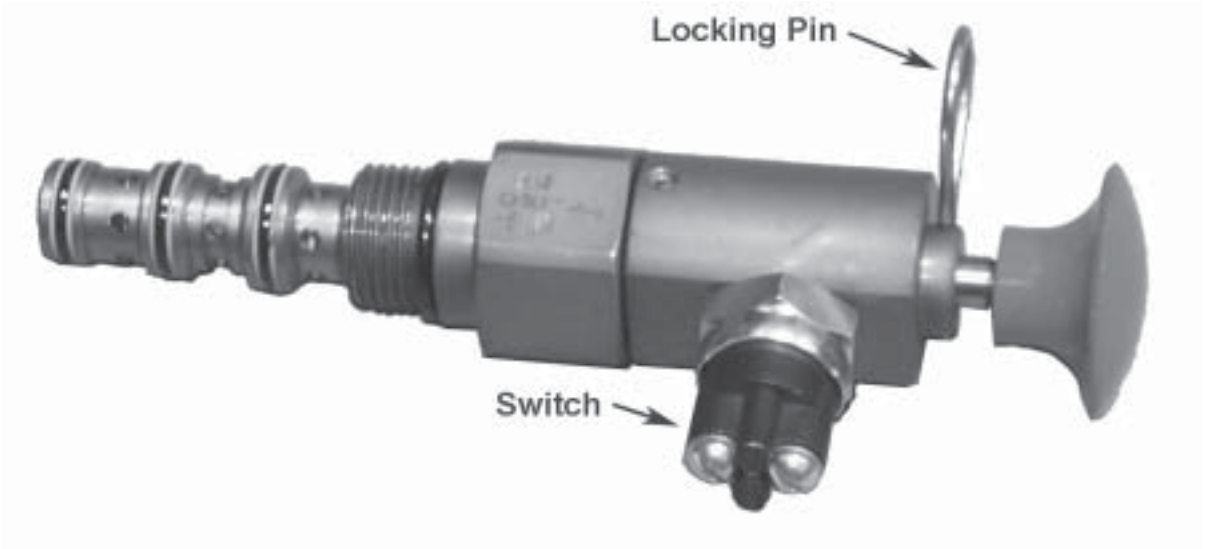


Figure 20. Manual Direction Control Valve

Trolling Valve (Optional)

The trolling valve is used to reduce and control propeller speed below that normally attained by operating the engine at low idle. Actuating the trolling function reduces clutch apply pressure to reduce the propeller speed.

The trolling valve for this transmission does not control the pressure in the rate-of-rise chamber when in the trolling mode, it controls the flow of oil to the engaged clutch. Trolling is achieved by restricting the flow of main pressure oil to the engaged clutch, which ultimately controls the pressure in the engaged clutch of the transmission. The trolling feature is available when the selector valve is in the electric mode, but is disabled when the selector valve is in the manual override mode.

Main pressure oil can flow into the trolling valve through a fixed orifice at all times. Oil may exit the trolling valve through a variable orifice. The size of the variable orifice depends on the trolling valve lever position.

When the trolling valve lever is in the detented position, the variable orifice is closed. Since oil can flow into the trolling valve through the inlet orifice and is not allowed to escape, the oil pressure inside the trolling valve rises to match main oil pressure. This oil pressure inside the trolling valve pushes the piston assembly over to compress the large diameter spring behind it. The compressed spring pushes the flow control piston against its return spring, allowing unrestricted flow of oil to the engaged clutch. Unrestricted flow of oil to the engaged clutch results in full clutch apply pressure.

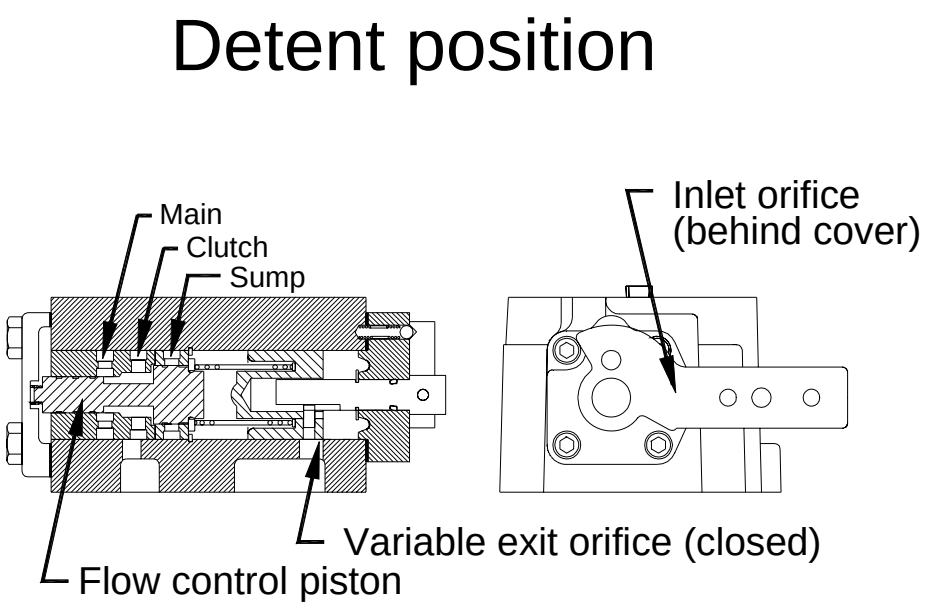


Figure 21. Trolling Valve in Non-trolling Position

Rotation of the trolling valve lever into the trolling mode opens the variable orifice, allowing some of the oil in the trolling valve to flow to sump. This reduction in oil pressure within the trolling valve allows the piston assembly to move towards the lever end of the valve, reducing the amount of compression in the spring behind it. Since the spring is no longer fully compressed, the flow control piston moves in its bore, and restricts the flow of main pressure oil to the engaged clutch. This causes the clutch apply pressure to be reduced, allowing the clutch plates in the transmission to slip. The amount of pressure reduction and resulting clutch slip is ultimately controlled by the trolling valve lever position.

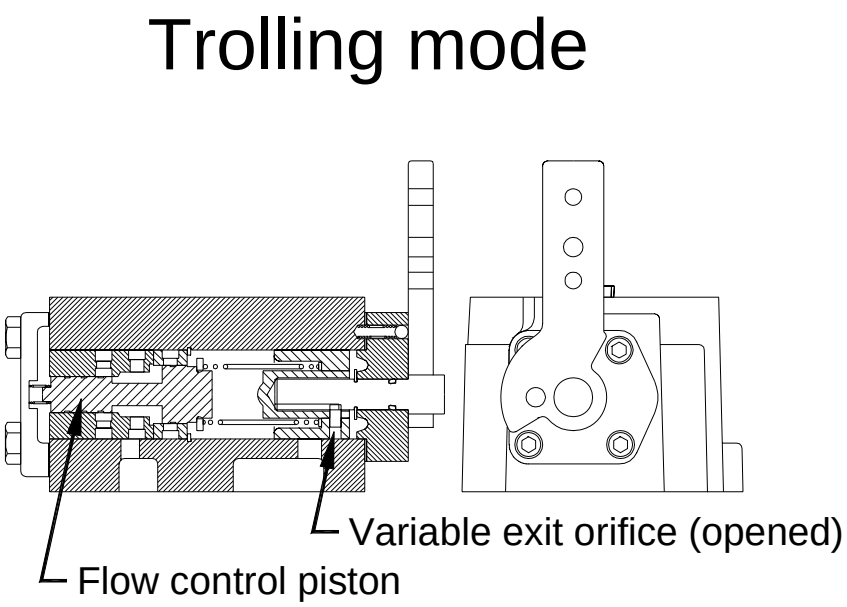


Figure 22. Trolling Valve in Trolling Position

Power Take-off (Optional)

There are two types of power take-offs available for this marine transmission. Both are designed to drive hydraulic pumps meeting SAE-J-744 with flange size 127, and shaft size 32-4

Live Pump Mount Power Take-off

The live pump mount power take-off drives accessories using engine horsepower. Since the live power take-off connects the accessory to the primary shaft of the transmission via a direct coupling, the accessory is driven when the engine is running.

Hydraulic Clutched Pump Mount Power Take-off

The hydraulic clutched power take-off also allows accessories to be driven using engine horsepower. Since the power take-off is attached to the primary shaft of the transmission, the accessories can be driven any time the engine is running. The power take-off is engaged by the power take-off electric control valve that can be engaged manually if necessary.

The hydraulic clutched power take-off operates with oil pressure supplied by the transmission's hydraulic system.

Trailing Pump (Optional)

The trailing pump is used to supply oil flow to the transmission lubrication circuit when the transmission is in a backdriving condition. Backdriving (sometimes referred to as “windmilling”) occurs when the engine is shut down and the transmission output shaft is being driven by water flow across the propeller.

The trailing pump is driven by the output shaft, and oil flow from the trailing pump flows through a check valve into the transmission’s lubrication circuit below the heat exchanger.

Power Flow

Input power to the transmission is through a driveline connected to the engine flywheel. The driveline is connected to the engine end of the primary (forward clutch) shaft causing the primary shaft to rotate in engine direction during engine operation. Power is transmitted to the secondary shaft by means of the transfer gear teeth on the outer diameter of the primary clutch housing. These teeth are in constant mesh with gear teeth on the secondary clutch housing causing the secondary shaft to rotate in anti-engine direction. The primary and secondary pinions on their respective shafts, are in constant mesh with the output gear, which is connected to the output shaft through a keyless tapered joint.

Application of the primary clutch locks the primary pinion to the primary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in anti-engine direction. Application of the secondary clutch locks the secondary pinion to the secondary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in engine direction.

Neutral

When in Neutral the primary and secondary shafts, transfer gears and clutch friction plates rotate at engine speed.

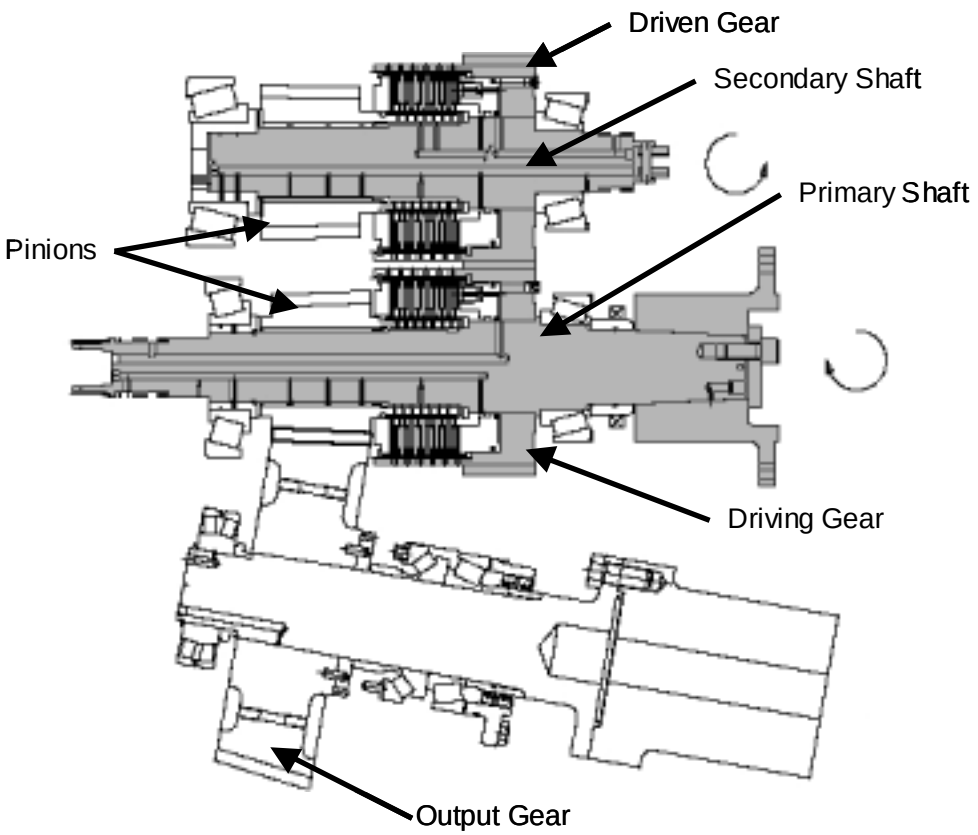


Figure 23. MG-6449RV Power Flow in Neutral

Primary

When the Primary position is selected, hydraulic pressure is applied to the primary clutch piston clamping the friction and steel clutch plates together. The primary input pinion will then rotate at engine speed and direction because the steel plates are spline-connected through the clutch hub assembly to the pinion. Because the primary input pinion is in mesh with the output gear, the output gear and shaft will rotate in anti-engine direction. The secondary input pinion will be backdriven (engine direction) when the unit is in the primary position.

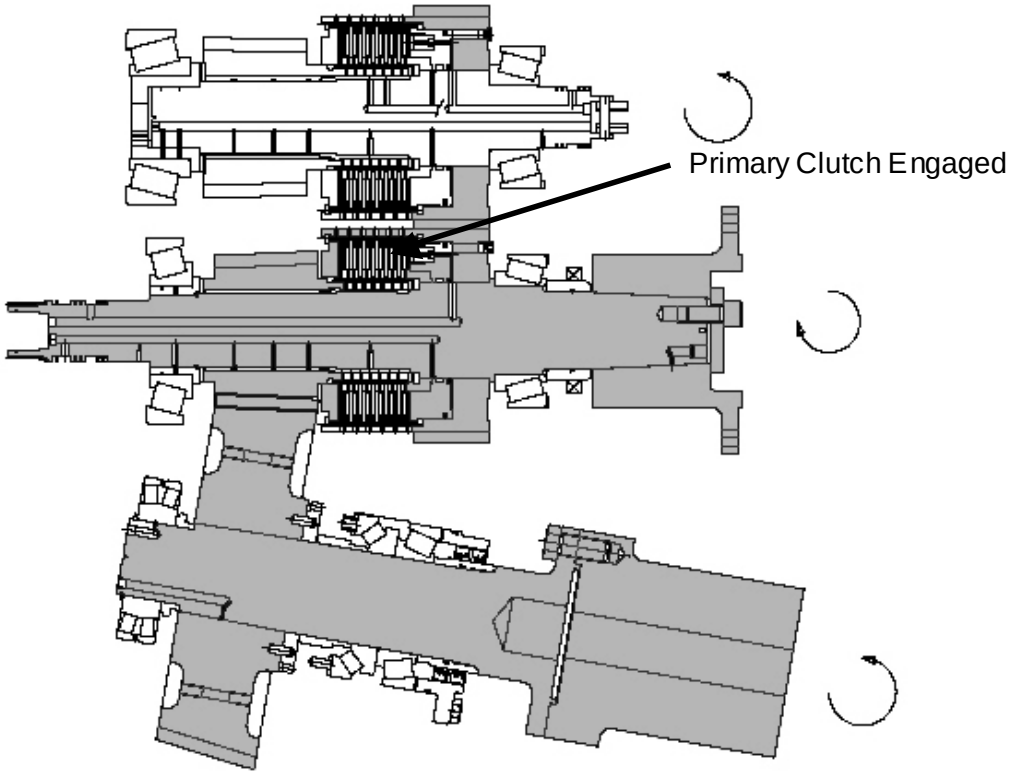


Figure 24. MG-6449RV Power Flow with Primary Clutch Engaged

Secondary

In Secondary, the same parts are turning that were turning in Neutral. When the secondary position is selected, hydraulic pressure is applied to the secondary clutch piston clamping the friction and steel plates together. The secondary input pinion will then rotate at engine speed and anti-engine direction, because the steel clutch plates are spline connected through the clutch hub assembly to the input pinion. Because the secondary input pinion is in mesh with the output gear, the output gear and shaft will rotate in engine direction. The primary input pinion will be backdriven (anti-engine direction) when the unit is in the secondary position.

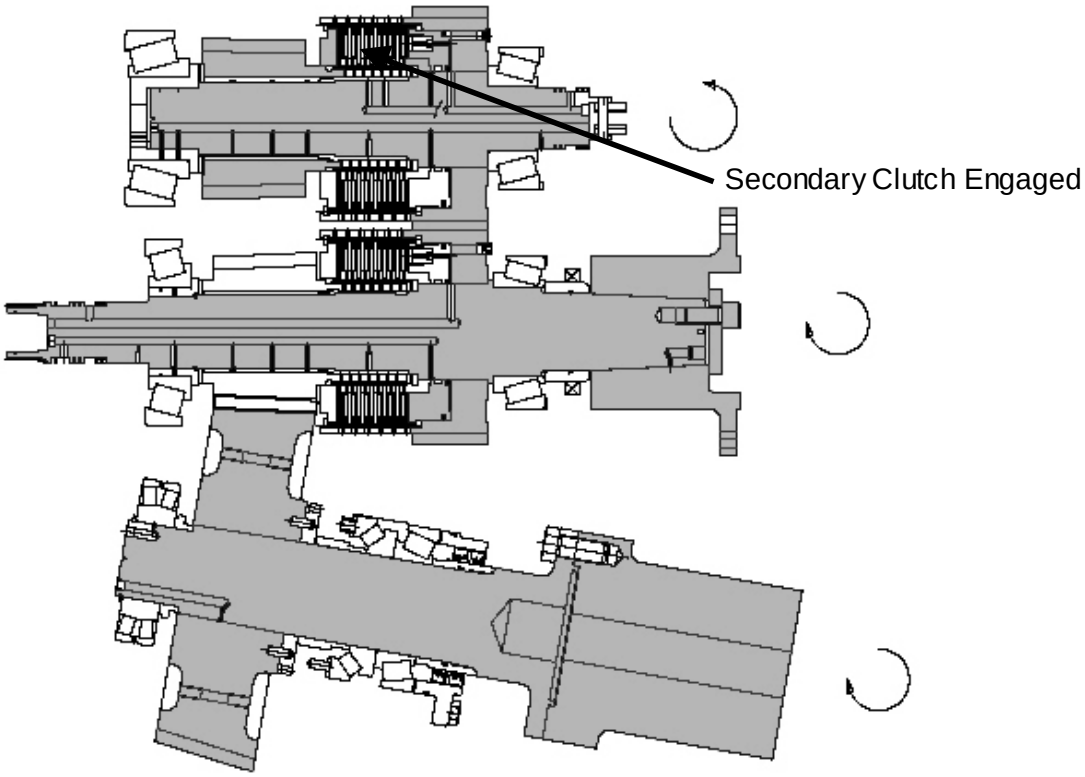


Figure 25. MG-6449RV Power Flow with Secondary Clutch Engaged

Preventative Maintenance

Lubrication

Grease the oil seals on the output end of the output shaft through the grease fitting with water pump (lithium soap-based NLGI No. 2) grease. Apply grease every 100 hours or when the boat is docked.

No other lubrication is required beyond the daily oil check.

Oil System

Oil Level

The oil level should be checked daily or every 10 hours. Check oil level before starting the engine to confirm that the transmission has oil in it. With the engine running at low idle and the transmission in Neutral, check the oil again. The oil level should be near the “low” oil level mark. Transmission oil temperature should be in the normal operating range prior to finalizing the oil level between the low and full marks on the oil level gauge.

Oil and Filter Change Interval

With a new transmission, change the oil and filter element within the first 50 hours of operation. Change oil and filter element after each 1000 hours thereafter or more often if conditions warrant.

For a rebuilt transmission, check the filter element after eight hours of operation. If the filter is clean, install a new filter element and then change the oil and filter element after 1000 hours of service. If the filter is dirty, change the element and operate for another eight hours. Check the filter again. Continue this cycle until the filter is clean and then change the oil and filter after 1000 hours of service or more often if conditions warrant.

Draining

Drain the transmission by removing the oil drain flanges at the bottom of the housing on the driveline side.

Oil Suction Strainer

Remove and clean the pump suction strainer at every oil change or sooner if necessary. The suction strainer is located at the lower end of the pump. See Engineering Drawings for suction strainer location.

Type Oil Recommended

See Description and Specifications.

Filling

1. Remove the filler breather in the top cover of the transmission.

2. Fill the transmission's sump with 18 liters (4.8 U.S. gal.) Of the proper weight and type oil. See Description and Specifications for oil recommendations.

3. Start the engine and let it idle with transmission in neutral until oil is circulated throughout the hydraulic system. Add oil if necessary to bring the oil level up to the "low" mark with the engine at low idle.

4. With the oil at operating temperature, transmission in neutral, and the engine running at low idle, check the oil level with the oil gauge. Add or remove oil if necessary to bring the oil level to "FULL" mark on the oil gauge.

5. Allow the oil temperature to cool to normal cold oil conditions (overnight). Check the oil level while cold at low idle engine speed while in neutral. Make note of the oil level in the cold conditions for future reference, as it corresponds to the correct oil level at operating temperature.

Torsional Coupling

Note: The torsional coupling is not supplied with the MG6449RV marine transmission. This information is included for the operators use in the event that no other information is available for the torsional coupling that may be mounted on the engine flywheel.

Do not obstruct the flywheel housing vents preventing the free flow of air for cooling the coupling. The ambient temperature of the air around the coupling should be between -6˚C (22˚F) and 80˚C (176˚F). Assure baffles are installed properly so hot air is ported out of the housing.

Visually inspect the element after the first 100 hours of operation and every 2000 hours thereafter, or every six months, whichever comes first. Torsional vibration, misalignment, degradation by contaminants (oil), heat, ultraviolet radiation, and excessive system torque can cause cracks or other signs of distress to appear on the surface of the rubber. The above-described items affect the life of the coupling element.

When inspecting the flexible coupling, look for evidence or conditions identified in the following steps:

- ❑ Cracks in the surface of the rubber. May be caused by torsional vibrations, excessive misalignment or exposure to contaminants (heat, petroleum products, chemicals, ozone, ultraviolet radiation, etc.) excessive system torques.
- ❑ Separation of rubber from flex plate on coupling plate or deterioration of the rubber-to-metal bond. See above.
- ❑ Deterioration of the rubber element, as evidenced by sponginess or by black carbon-like dust on rubber surface. May be caused by contaminants or excessive heat, either external or internal to the coupling.
- ❑ Cracked, bent or otherwise damaged flex plate or coupling plate.
- ❑ Bolt holes in flex plate or coupling plate elongated oval shaped, not round. This could be caused by improperly assembled parts, loose parts, vibration or improperly torqued parts.
- ❑ Bolts/nuts—bent, worn or stripped threads.

Inspect the hub, looking for the following:

- ❑ Damaged or worn splines.
- ❑ Cracked parts.
- ❑ Oil seal surface for wear or damage.

Replace any defective parts including defective fasteners that are found.

Heat Exchanger Check

Heat exchangers furnished by Twin Disc to be used for salt water applications have zinc rods installed at the inlet and outlet heads. These rods must be checked every 90 days. If over 50% of the rod is disintegrated, it should be replaced to provide effective protection.

Excessive corrosion of the zinc rod indicates electrolytic action. A careful inspection should be made to determine if this action is caused by a short circuit or external grounded electric current. If these conditions do not exist, it is evident that the corrosion is due to local electrolysis. If rods are corroded with foreign materials, they should be cleaned with a wire brush.

In-boat Repair

Certain transmission maintenance/repair procedures can be accomplished in the boat provided sufficient space exists to work. These procedures are:

- ❑ Removing and installing the oil pump.
- ❑ Changing the filter.
- ❑ Removing, cleaning and installing the suction strainer.
- ❑ Removing and installing the control valve.
- ❑ Removing and installing the manifold or top cover, and bearing carrier.
- ❑ Removing and installing the clutch shaft assemblies for overhaul.

Overhaul Interval

A complete overhaul of the unit should be made at the same time that the engine is overhauled.

Periodic Visual Inspection

- ❑ Check the mounting for tightness or damage such as cracks. Tighten loose mounting and replace damaged parts.
- ❑ Check pressure and temperature gauge where applicable.
- ❑ Inspect the oil lines and heat exchanger for leaky connections, cracks, or other damage. Replace damaged lines.
- ❑ Periodically, inspect the drive line and the input and output shaft oil seals for leakage. Replace parts as required.

Troubleshooting

Troubleshooting of Mechanical and Electric Control Valves

General

Note: Some of the troubleshooting procedures vary, depending on the type of control valve that is installed on the transmission. A thorough understanding of the valve operation is important to properly troubleshooting the problem that is occurring.

The following charts are intended as a guide for determining the cause of problems that could be encountered and the corrective actions for those difficulties.

The transmission is one part of a complete power package. Problems in the input power system or the output power delivery components can cause problems to develop in the transmission. It is therefore important that the entire power package be considered when problems are encountered.

Pressure Test Kit

The Digital Pressure Transducer Kit (BOM 42168) provides two pressure transducers (0 to 500 psi) with hydraulic quick couplings, a power supply box for the transducers, and cables needed to connect the transducers to the power supply box and the signals out of the power supply box to a customer supplied digital volt meter. Contact the Twin Disc Service Department, Racine Wisconsin for specific information concerning this test kit.

One principle of troubleshooting is to start with the simple and move to the more difficult. Check the simple items first. Run the simple test first. Then move to the more difficult.

Figure 26. Test kit 42168

Table 9. Troubleshooting Chart - Mechanical and Electric Control Valves

Symptom	Cause	Remedy
1. Low main oil pressure.	1-1. Partially clogged oil strainer.	1-1. Remove and clean oil strainer.
	1-2. Stuck pressure regulation piston.	1-2. Disassemble the valve and clean the piston.
	1-3. Broken piston rings on clutch shaft(s).	1-3. Remove the collector and inspect piston rings.
	1-4. Damaged or worn oil pump assembly.	1-4. Replace damaged or worn oil pump assembly.
	1-5. Incorrect linkage adjustment to control valve assembly.	1-5. Adjust linkage so that valve stem is indexed properly by detent.
	1-6. Clogged or plugged orifice in orifice plate of control valve assembly.	1-6. Remove orifice plate cover. Clean parts.
	1-7. Shimming required between regulator springs and rate-of-rise piston.	1-7. Shim as required.
	1-8. Engine idle speed too low.	1-8. Raise engine speed.
2. No oil pressure, or erratic low pressure at control valve tap.	2-1 Oil pump strainer plugged.	2-1. Remove and clean strainer.
	2-2. Oil level low.	2-2. Check oil level and correct.
	2-3. Air leak on suction side of pump.	2-3. Correct cause of air leak.
	2-4. Pump drive on reverse clutch shaft broken.	2-4. Disassemble and repair as required.
	2-5. Regulating valve stuck in open position.	2-5. Remove, disassemble, clean and repair the regulating valve.
	2-6. Oil pump defective.	2.6. Replace oil pump.
	2.7. Leaking heat exchanger has caused oil to be lost over board.	2.7. Replace heat exchanger.
3. High main oil pressure	3-1. Regulating valve stuck.	3-1. Remove and clean regulating valve.
	3-2. Improperly shimmed.	3-2. Shim as required.
	3-3. Lube relief valve malfunction.	3-3. Inspect, repair or replace parts as necessary.

Table 9. Troubleshooting Chart - Mechanical and Electric Control Valves (continued)

Symptom	Cause	Remedy
4. High temperature.	4-1. Improper oil level.	4-1. Check and fill (or drain) with proper oil to the correct level.
	4-2. Faulty heat exchanger.	4-2. Inspect, repair or replace heat exchanger.
	4-3. Clutches slipping.	4-3. Check clutch apply oil pressure. If pressure is normal, remove, disassemble, and repair slipping clutch.
	4-4. Bearing failure.	4-4. Overhaul marine transmission.
	4-5. Air leak on suction side of pump.	4-5. Inspect and correct cause of suction leak.
	4-6. Control valve malfunction.	4.6. Inspect, repair, or replace control valve.
5. Excessive noise.	5-1. Bearing failure.	5-1. Overhaul marine transmission.
	5-2. Worn or damaged input coupling.	5-2. Remove marine transmission. Replace a worn or damaged coupling.
	5-3. Excessive torsional vibration.	5-3. Select proper torsional coupling.
	5-4. Worn or damaged gears.	5-4. Overhaul marine transmission.
	5-5. Improper alignment.	5-5. Check alignment of engine transmission output flange to propeller shaft. Correct as necessary.
	5-6. Damaged propeller.	5-6. Repair propeller.
	5-7. Misfiring engine.	5-7. Repair engine.
6. No neutral.	6-1. Clutch plates warped.	6-1. Remove clutch plates. Overhaul unit.
	6-2. Control valve incorrectly indexed.	6-2. Check and adjust control linkage.
	6-3. Solenoid malfunction (units equipped with electric selector valve).	6-3. Replace defective solenoid.
	6-4. Hydraulic lock piston stuck (units equipped withelectric selector valve).	6-4. Inspect, repair or replace hydraulic lock spool.

Table 9. Troubleshooting Chart - Mechanical and Electric Control Valves (continued)

Symptom	Cause	Remedy
7. Harsh engagement.	7-1. Regulating piston or rate-of-rise piston stuck.	7-1. Disassemble control valve. Clean parts. Replace parts if necessary.
	7-2. Orifice plate ball in control valve not seating properly.	7-2. Remove orifice plate cover. Clean parts. Replace parts if necessary.
	7-3. Blown gasket on either side of orifice plate.	7-3. Replace gasket.
8. Oil spilling out of breather.	8-1. Pump flow output too low.	8-1. Replace pump.
	8-2. Pump suction strainer plugged.	8-2. Remove, clean, inspect, and install the suction screen.
	8--3. Air leak on suction side of pump.	8-3. Inspect and correct cause of suction leaks.
	8-4. Lube relief valve malfunction.	8-4. Remove and clean or replace parts as necessary.
	8-5. Broken piston rings.	8-5. Replace damaged piston rings.
9. Oil spilling out of breather.	9-1. Oil level too high.	9-1. Adjust oil level.
	9-2. Wrong type of oil.	9-2. Draw and refill with recommended oil.

Troubleshooting of GP Control Valve with Electronic Interface

General

The transmission is one part of a complete power package. Problems in the input power system or the output power delivery components can cause problems to develop in the transmission. It is therefore important that the entire power package be considered when problems are encountered.

Electronic Interface LED Indicators

The electronic interface control modules have one green and two red led indicator lights. The green power light is illuminated only when the transmission is in gear.

The following table lists the reasons for the various conditions where lights are illuminated. This should guide in troubleshooting problems. See the wiring schematics in the Installation Section.

Troubleshooting Tables begin on the next page.

Table 10. LED Light Status

Light Status	Profile Generator (Non trolling)	E-troll Module
Green light on	Supply Voltage > 9.0 Volts	Supply Voltage > 9.0 Volts
Red light on	Valve coil commanded on	Valve coil commanded on
One red light flashing	All Units: Open circuit in an energized valve coil circuit. MG Units only: Valve coil leads shorted together, or Low coil current	Open circuit in an energized valve coil circuit, or Valve coil leads shorted together, or Low coil current
Both red lights flashing simultaneously	MG Units: Power is applied to Solenoid A and B switch inputs at the same time. MGX Units: Not Applicable.	After entering troll from neutral with both voltage and current troll speed signals present, or power is applied to Solenoid A and B switch inputs at the same time.
Both red lights flashing alternately	Not applicable	Either or both speed signals missing.

Table 11. Troubleshooting Chart - GP Manual Control Valve with Electronic Interface

Symptom	Cause	Remedy
1. Low main oil pressure.	1-1. Partially clogged oil strainer.	1-1. Remove and clean oil strainer.
	1-2. Contamination on Pilot Relief Valve seat.	1-2. Disassemble the Pilot Relief Valve and clean. Service the transmission oil filter.
	1-3. Contamination in Main valve Cartridge.	1-3. Clean or replace Main Valve cartridge and service the transmission oil filter.
	1-4. Broken piston rings on clutch shaft(s).	1-4. Remove the collector and inspect the piston rings.
	1-5. Damaged or worn oil pump assembly.	1-5. Replace damaged or worn oil pump assembly (pump is not serviceable).
	1-6. Engine idle speed too low.	1-6. Raise engine speed.
2. No oil pressure, or erratic low pressure at control valve tap.	2-1 Oil pump suction strainer plugged.	2-1. Remove and clean strainer.
	2-2. Oil level low.	2-2. Check oil level and correct.
	2-3. Air leak on suction side of pump.	2-3. Correct cause of air leak.
	2-4. Pump drive on reverse clutch shaft broken.	2-4. Disassemble and repair as required.
	2-5. Pilot Relief Valve or Main Regulating Valve stuck in open position.	2-5. Remove, disassemble, clean and repair the Pilot Relief Valve. Remove, clean or replace the Main Regulating Valve. This valve cannot be disassembled.
	2-6. Oil pump defective.	2.6. Replace oil pump.
	2.7. Leaking heat exchanger has caused oil to be lost over board.	2.7. Replace heat exchanger.
3. High main oil pressure	3-1. Pilot Relief Valve is out of. adjustment.	3-1. Adjust Pilot Relief Valve. Replace if necessary.
	3-2. Main Regulating Valve orifice missing.	3-2. Replace Main Regulating Valve cartridge.

Table 11. Troubleshooting Chart - GP Manual Control Valve (continued)

Symptom	Cause	Remedy
4. High temperature.	4-1. Improper oil level.	4-1. Check and fill (or drain) with proper oil to the correct level.
	4-2. Faulty heat exchanger.	4-2. Inspect, repair or replace heat exchanger.
	4-3. Clutches slipping.	4-3. Check clutch apply oil pressure. If pressure is normal, remove, disassemble, and repair slipping clutch. If pressure is low, replace Proportional Valve and service the transmission oil filter.
	4-4. Bearing failure.	4-4. Overhaul marine transmission.
	4-5. Air leak on suction side of pump.	4-5. Inspect and correct cause of suction leak.
	4-6. Control valve malfunction.	4.6. Inspect, repair, or replace control valve.
5. Excessive noise.	5-1. Bearing failure.	5-1. Overhaul marine transmission.
	5-2. Worn or damaged input coupling.	5-2. Remove marine transmission. Replace a worn or damaged coupling.
	5-3. Excessive torsional vibration.	5-3. Select proper torsional coupling.
	5-4. Worn or damaged gears.	5-4. Overhaul marine transmission.
	5-5. Improper alignment.	5-5. Check alignment of engine transmission output flange to propeller shaft. Correct as necessary.
	5-6. Damaged propeller.	5-6. Repair propeller.
	5-7. Misfiring engine.	5-7. Repair engine.
6. No neutral.	6-1. Clutch plates warped.	6-1. Remove clutch plates. Overhaul unit.
	6-2. Disengaged clutch has apply pressure.	6-2. Replace Proportional Valve. Service Transmission oil filter.

Table 11. Troubleshooting Chart - GP Manual Control Valve (continued)

Symptom	Cause	Remedy
7. Harsh engagement.	7-1. Faulty Proportional Valve. 7-2. Faulty Temperature Sensor (if equipped). 7-3. Profile Generator defective or out of adjustment.	7-1. Replace Proportional Valve. 7-2. Replace Temperature Sensor. 7-3. Replace Profile Generator. Adjust if proper equipment is available.
8. Low lube pressure	8-1. Pump flow output too low. 8-2. Pump suction strainer plugged. 8--3. Air leak on suction side of pump. 8-4. Lube relief valve malfunction. 8-5. Broken piston rings.	8-1. Replace pump. 8-2. Remove, clean, inspect and install the suction screen. 8-3. Inspect and correct cause of suction leaks. 8-4. Remove and clean or replace parts as necessary. 8-5. Replace damaged piston rings.
9. Oil spilling out of breather.	9-1. Oil level too high. 9-2. Wrong type of oil.	9-1. Adjust oil level. 9-2. Draw and refill with recommended oil.
10. Low Clutch Apply Pressure	10-1. Low Main Pressure 10-2. Defective Proportional Valve. 10-3. Low voltage to Profile Generator	10-1. See Paragraph 1. 10-2. Replace Proportional Valve. 10-3. Verify that green (voltage supply) light and red (clutch energized) lights are bright.

NOTES

Disassembly

Prepare Transmission for Disassembly

Note: During the service of this unit, all O-rings, gaskets and seals must be replaced. It is good practice to keep the used components (O-rings, gaskets, and seals) with the appropriate components for reference during the inspection and assembly process (to make sure you don't forget the quantity, size, etc.).

⚠ CAUTION

Flat washers are used under all fasteners where the head of the fastener contacts an aluminum surface.

Pipe threads called out as PT (BRITISH STANDARD PIPE-TAPER) on drawings and in this text are different from NPT threads. PT threads and NPT threads are NOT interchangeable. Adapters are available from several manufacturers to convert PT threads to NPT threads.

Most pusher screws used in the disassembly of this transmission are threaded through aluminum parts. ALWAYS LUBRICATE the threads of the pusher screw before threading it into the mating part. When installing pusher screws, avoid rapid tightening with an impact wrench or similar device. If an impact wrench is used with the pusher screws the threads may gall or seize in the aluminum part. Tighten pusher screws in an even manner to avoid damaging components.

Component Identification

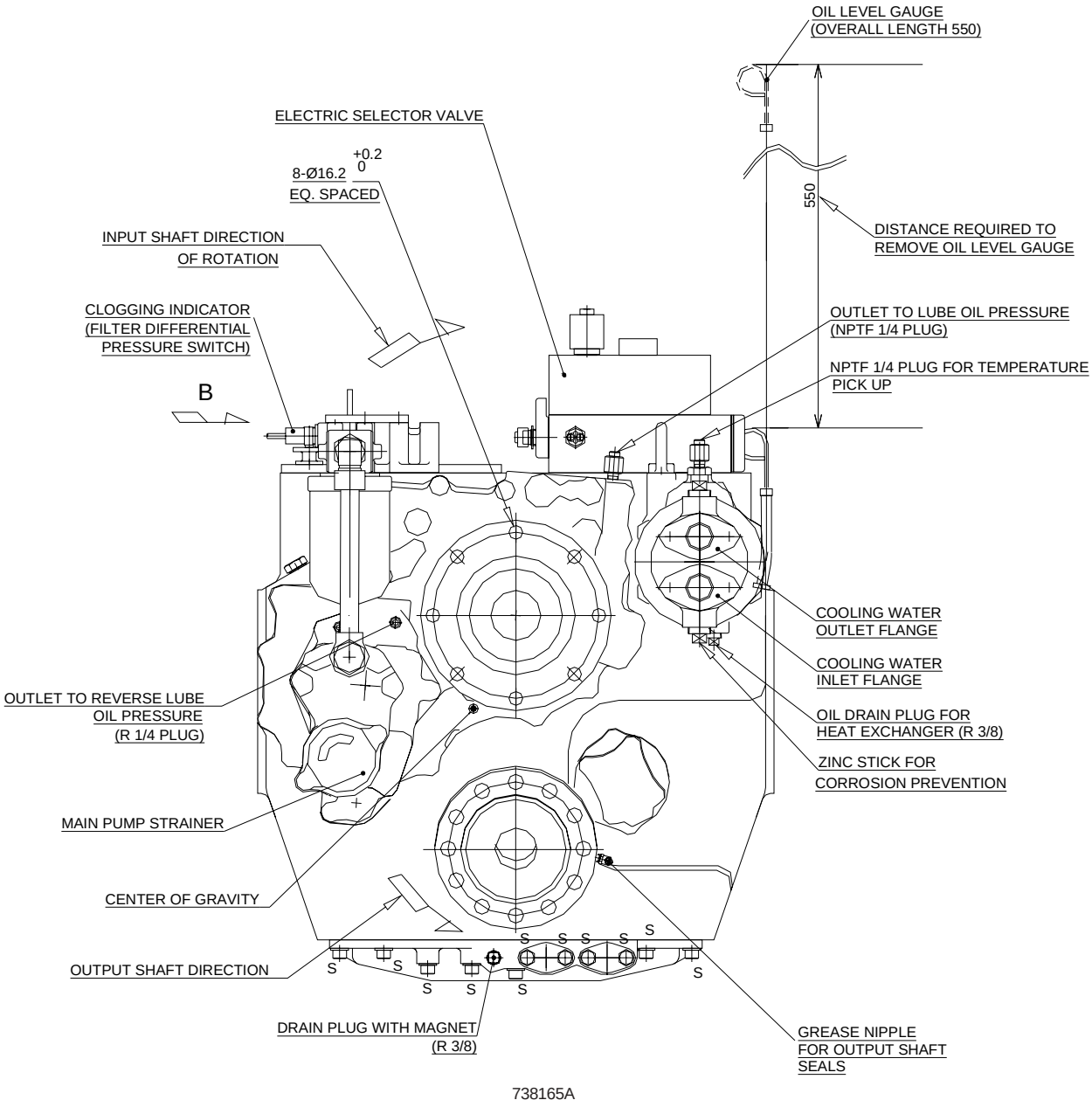


Figure 27. MG-6449RV Component Identification and Location

Drain Oil

Transmission Sump

Drain the oil from the transmission sump by removing the square head 3/8" PT pipe plug with magnet from the bottom, rear side of the transmission bottom housing.

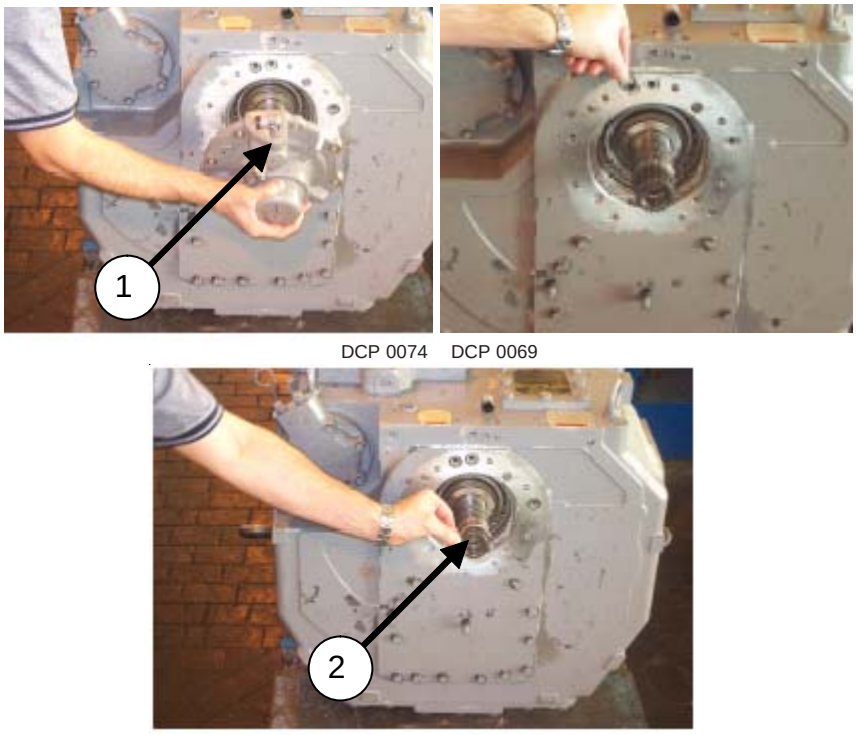
Heat Exchanger

Drain the oil from the heat exchanger by removing the pipe plug from the bottom of the heat exchanger rear cover.

Remove Transmission External Components

Supply Cover and Output Shaft Cover

1. Remove 8 capscrews and remove the supply cover..
   a. Gently tap the cover [1] to break the sealer bond from the transmission housing.
   b. Remove the (2) O-rings located on the transmission housing.
   c. Remove the four seal rings [2]. Tag the seal rings with identifying information.



DCP 0074 DCP 0069

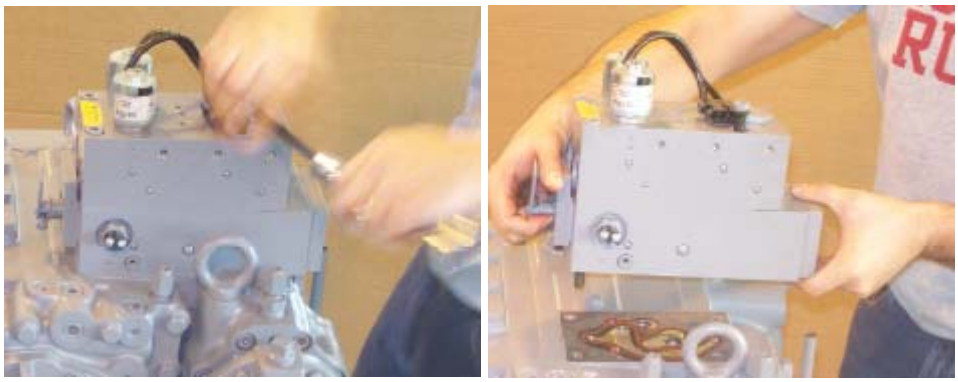
DCP 0072

Figure 28 Supply Cover and Output Shaft Cover Removal

2. Remove nine capscrews and remove front output shaft cover.

Selector Valve

1. Remove the selector valve. (4 of M10-1.5 x 150mm with washer)



DCP 0108 DCP0110

Figure 29. Selector Valve Removal

⚠ CAUTION

There is nothing holding the top half of the valve to the bottom half once the four screws are removed. Be careful not to drop the valve.

Heat Exchanger

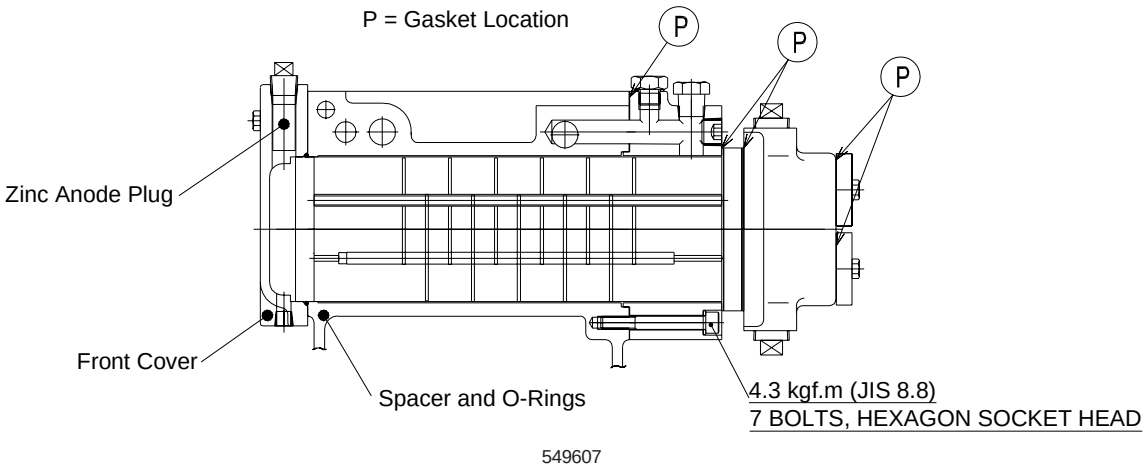


Figure 30. Heat Exchanger Component Identification and Location

1. Remove the front cover [1] and gasket from the heat exchanger. (6 of M8-1.5 x 55mm).

2. Remove the O-ring [2] and place it together with the front cover.

3. Mark the heat exchanger core [3] at the top to ensure it will be replaced into the transmission housing correctly.

   Note: Place a container at the bottom of the rear cover to hold the lubricants.

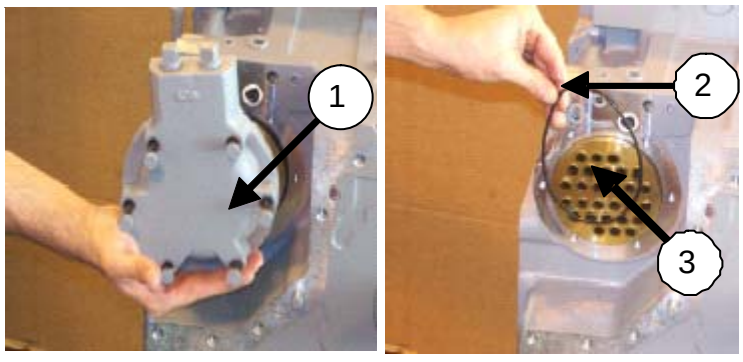


Figure 31. Heat Exchanger Cover Removal (1) and Core Indexing (2)

4. Remove the rear cover , from the heat exchanger. (6 of M8-1.5 x 50mm)

Note: Place a container at the bottom of the rear cover to hold the lubricants.

DCP 0112

Figure 32. Heat Exchanger Rear Cover Removal

5. Remove the heat exchanger core and the gasket is attached together with the heat exchanger rear cover mounting .

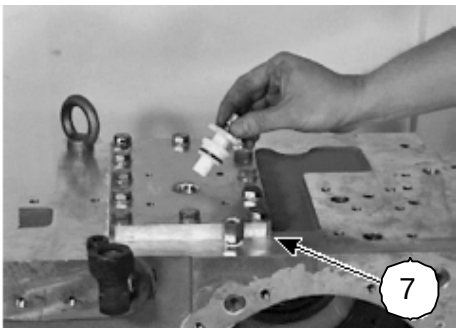
DCP 0115 DCP 0116

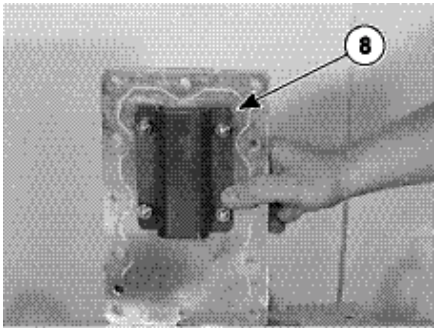
Figure 33. Heat Exchanger Core Removal

Top Cover with Oil Baffle & Cold Oil Relief Valve

1. Remove the transmission top cover [7]. The top cover contains the filler cap/breather.

   Note: On the bottom surface of the top cover is an oil baffle [8] to prevent oil leakage through the breather. Do not remove the baffle from the top cover unless replacement is necessary.





AR164 AR165

Figure 34. Top Cover Removal

2. Remove the Cold Oil Relief Valve located at the side of the transmission housing.

DCP 0129 DCP 0130

Figure 35. Cold Oil Relief Valve

Input Flange

1. Position the transmission with the input flange facing up. Be sure the transmission is supported securely. Remove three socket head capscrews and the retainer plate.

DCP 5787

Figure 36. Input Flange Removal

2. Identify location of oil injection port.

3. Install special tool T-21482-8.

4. Fill the shaft passage with SAE 40W oil.

5. Wrap the threads of the oil injection adapter with Teflon sealing tape.

6. Fill the oil injection adapter with SAE 40W oil. Lightly tap oil injection adapter to remove air entrapped in the passage. Refill the passage with oil as required until the passage is filled and all traces of air are removed.

7. Wrap the threads of the injection adapter screw with Teflon sealing tape and install the screw into the oil injection adapter.

8. Install a retaining tool to stop the input flange from suddenly coming all the way off and causing damage.

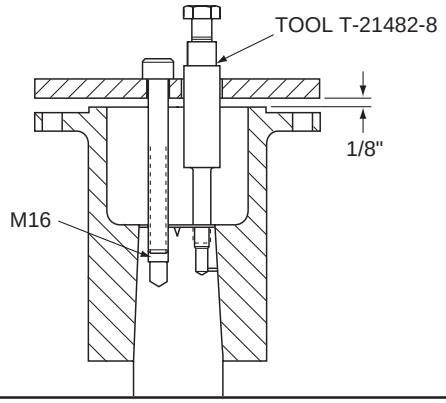


Figure 37 Input Flange Removal

⚠ WARNING

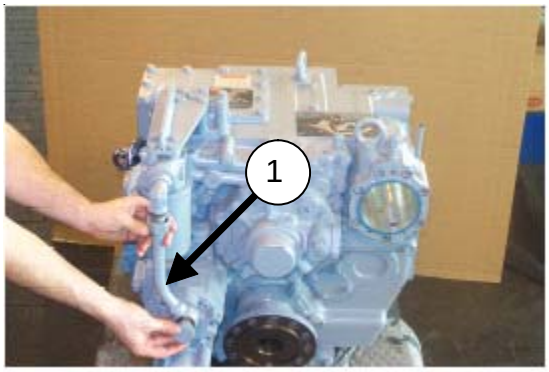
The input flange will separate with extreme force, potentially causing great physical harm. Use EXTRA CAUTION and proper safety procedures.

9. Hold the oil injection adapter to prevent rotation during operation and use an impact wrench to drive the screw into the oil injection adapter until the output shaft and output gear tapered surfaces separate.

   If the shaft and gear do not separate during the initial injection, repeat steps 6 through 9.

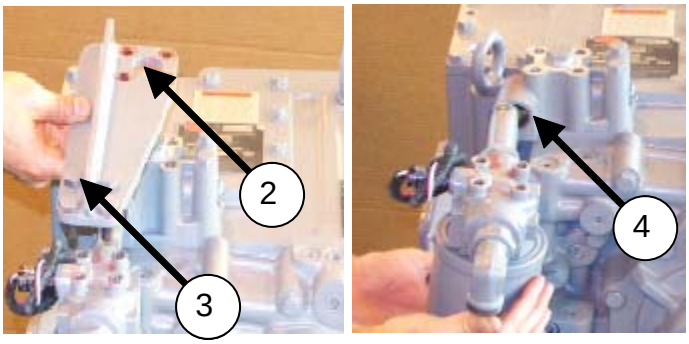
Oil Filter and Oil Pump

1. Remove the steel tube [1] between the pump and the filter.
There is a banjo fitting with a copper washer at the bottom, and a compression fitting at the top.



DCP 0090

Figure 38. Steel Tube Removal



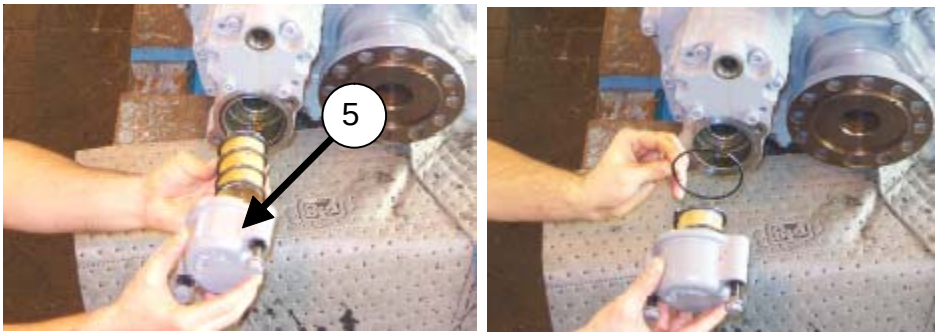
DCP 0120 DCP 0121

Figure 39. Bracket and Oil Filter Removal

2. Remove the bracket above the filter (4 of M 10-1.5 x 90mm at [2]) and (4 of M10-1.5 x 24 at [3]).

3. Two O-Rings seal the steel tube at the housing. The assembly can be removed by rotating and pulling the filter and tube with a slight force. The O-Rings are located at [4].

4. Remove the suction strainer cover [5] from below the pump and remove the suction strainer (2 of M10-1.5 x 65mm). The cover of the suction strainer is sealed with an O-ring. The suction strainer is located inside a spring to hold the suction strainer into position.



DCP 0123 DCP0 124

Figure 40. Suction Strainer [5] Removal

5. Remove the oil pump and the jumper tube located behind the pump (2 x M10 x 130, 3 x M10 x 105 and 1 x M10 x 185).A washer is needed under the head of the M10 x 185. The jumper tube is sealed at each end with an O-ring and is fitted into a suction adapter plate [6] on the rear side of the transmission.

6. Remove the gasket if it did not remain with the pump.

7. Remove the oil pump suction adapter plate [6]. Note the orientation of the suction adapter plate if removed, to assist in the re-assembly process.

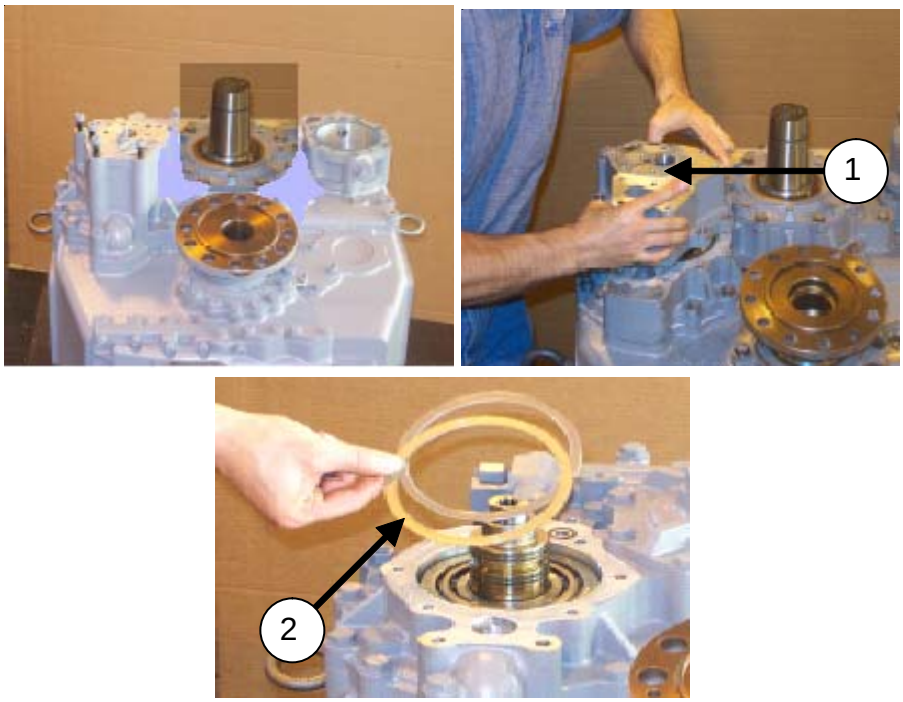
DCP 0126 DCP 0128

Figure 41. Oil Pump Removal

Remove Primary and Secondary Clutch Shaft Assemblies

Remove Clutch Shaft Covers

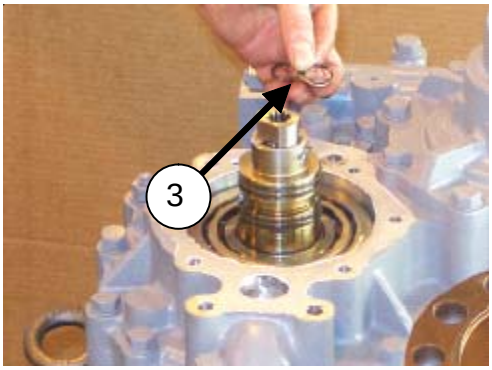
1. Remove the screws retaining the secondary clutch shaft cover [1] (4 of M10-1.5 x 115mm, 1 of M10-1.5 x 100mm, 1 of M10-1.5 x 35mm, 1 of M10-1.5 x 60mm, 1 of M10-1.5 x 45mm. All with washers).
   a. Gently tap the shaft cover to break the sealer bond from the transmission housing.
   b. Remove the cover [1], the shims and the bearing spacer [2], Tag the components with identifying information.



DCP 0133 DCP 5775 DCP0136

Figure 42. Secondary Clutch Shaft Cover Removal

2. Remove the 2 O-rings [3] located in the manifold counterbores.



DCP 0139

Figure 43. O-ring Removal From Manifold

DCP 5768

Figure 44. Primary Shaft Manifold Cover Removal

3. Remove the primary shaft manifold cover.

4. Remove bearing shims and tag with identifying information..

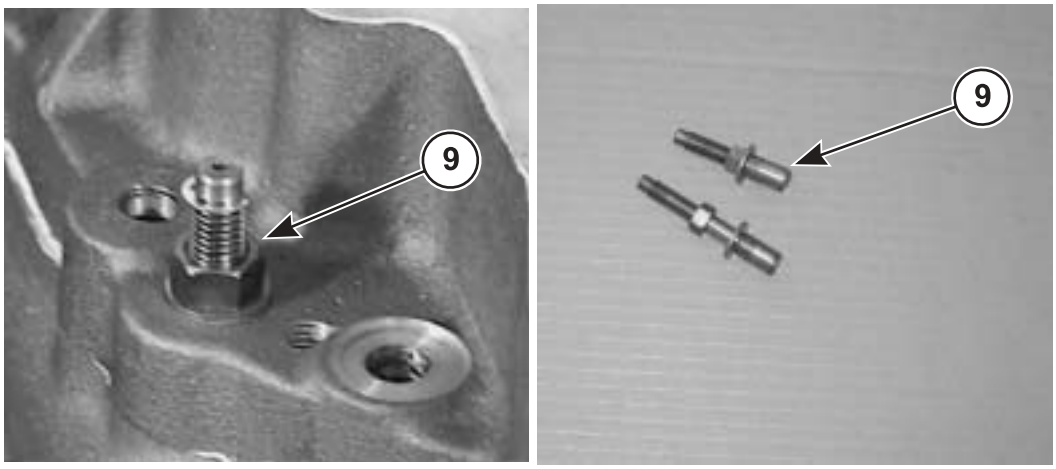
5. Remove O ring.

Remove Primary and Secondary Shaft Manifold

1. Remove the screws with washers retaining the manifold at the rear of the transmission housing (4 of M10-1.5 x 90mm, 5 of M10-1.5 x 65mm, 11of M10-1.5 x 45mm).

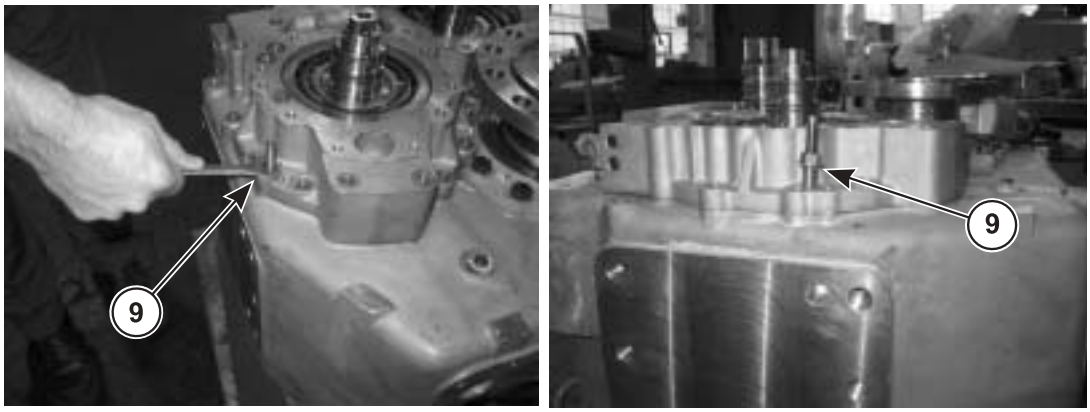
2. Remove the dowel pins [9] located at the side of the primary and secondary shaft. The Dowel Pins locate the bores concentric with the gear. Tighten the nut on the dowel pin (9) to pull the dowel out of the transmission housing. Tighten the nuts until they bottom on the end of threads. Pulling the dowel pin from the transmission housing will assist in removal of the manifold.

DCP 0145 DCP 0146



AR069 AR7026BE

Figure 45. Dowel Pins (9)



AR6557025BE AR6557029BE

Figure 46. Dowel Pin Removal

Remove Manifold

1. The manifold [2] is equipped with two pusher screw [1] locations near the dowel pins to assist in the removal of the oil manifold. Thread two M10-1.5 x 60 mm fully threaded cap screws (lubricated) into the pusher screw locations to push the oil manifold away from the transmission housing.

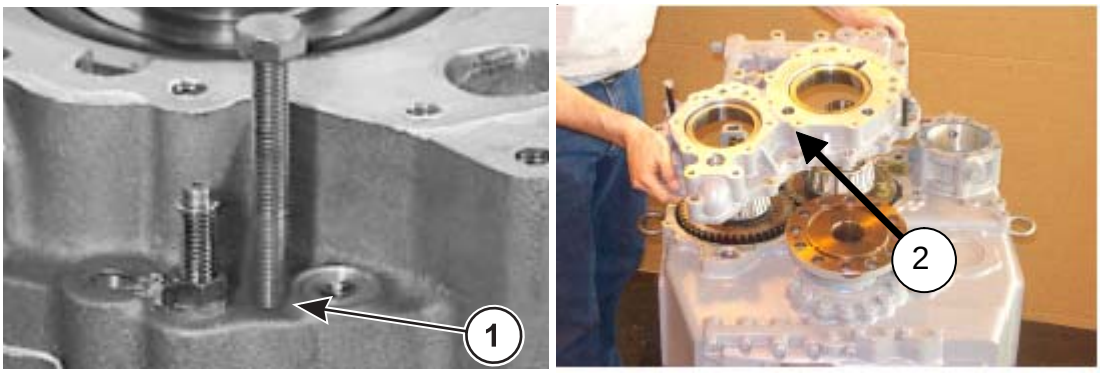
⚠ IMPORTANT

Always lubricate the pusher screw [1] threads before use. Always tighten pusher screws in an even manner.

2. Remove the manifold from the transmission housing.

⚠ CAUTION

Use caution in removing the manifold from the transmission housing. The forward and reverse shaft bearing cups could fall out of the manifold as it is being removed.



AR072 DCP 0147

Figure 47. Manifold (2) Removal

3. Remove the primary shaft and secondary shaft rear bearing cups [4] from the manifold.

Note: The primary and secondary shaft bearing cups are different from each other. Tag the components with identifying information.

4. Remove the O-rings located in the transmission housing behind the manifold.

AR079 DCP 0149

Figure 48. Primary and Secondary Clutch Shaft Bearing Cup (4) and Housing O-ring Removal

Remove Secondary and Primary Clutch Shafts

1. Install two lifting eyes (M10-1.5) into the secondary shaft transfer gear [5] and lift the shaft out of the transmission housing using the lift chain.

2. Install lifting eyes (M10-1.5) into the primary shaft transfer gear [6] and lift the shaft out of the transmission housing using the lift chain or use an appropriate lifting bracket.

   Note: Set the Primary and Secondary clutch shaft assemblies aside until further disassembly is required.

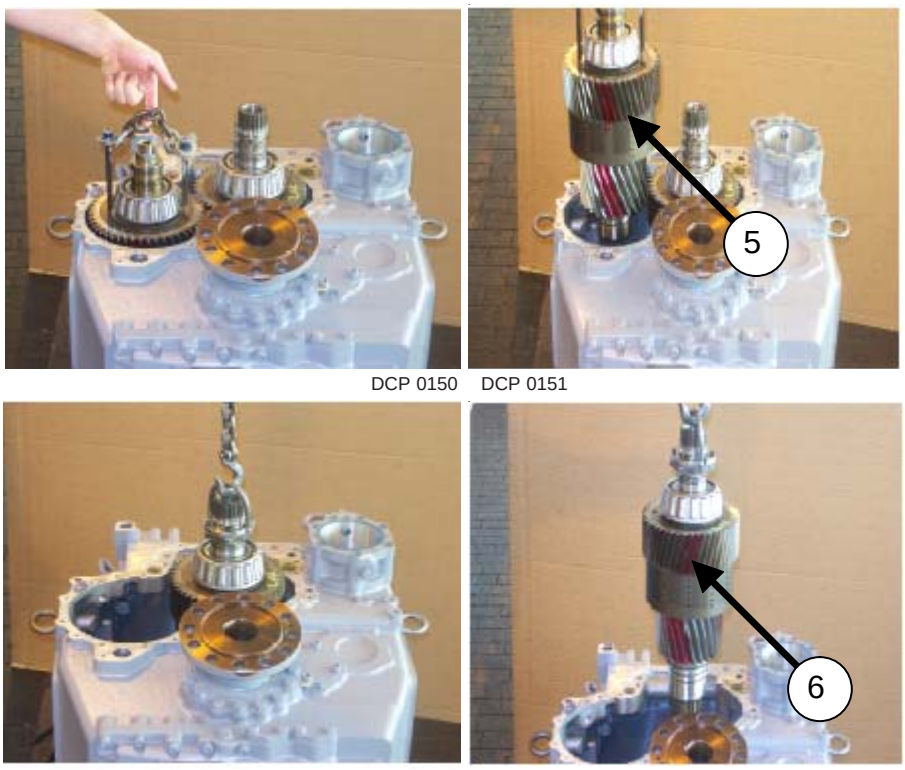
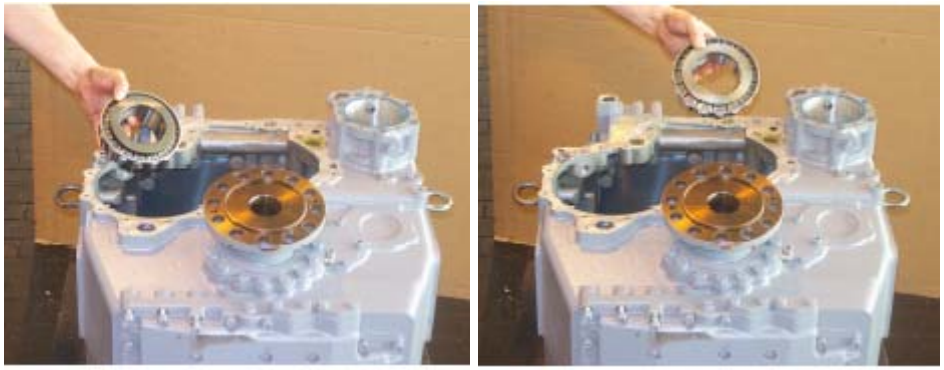


Figure 49. Lifting Secondary (5) and Primary (6) Clutch Shafts From Transmission Housing

Remove Primary and Secondary Shaft Front Bearing

1. Remove the Secondary and the primary tapered roller bearing after removing the shafts.

2. Remove the front bearing cups if they are to be replaced.



DCP 0156 DCP 0157

Figure 50. Primary and Secondary Shaft Front Bearing

Remove Output Shaft

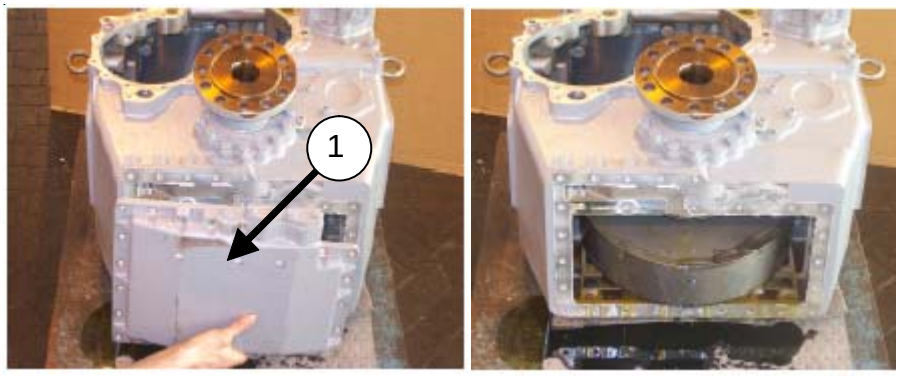
Remove the transmission bottom cover.

1. Remove the retaining screws from the bottom cover [1] of the transmission housing (17 of M10-1.5 x 30mm, 5 of M10-1.5 x 50mm, 4 of M10-1.5 x 60mm. All with washers). Be sure to remove the screws near the center of the cover.

⚠ IMPORTANT

The screws used to retain the bottom cover of the transmission are stainless steel.

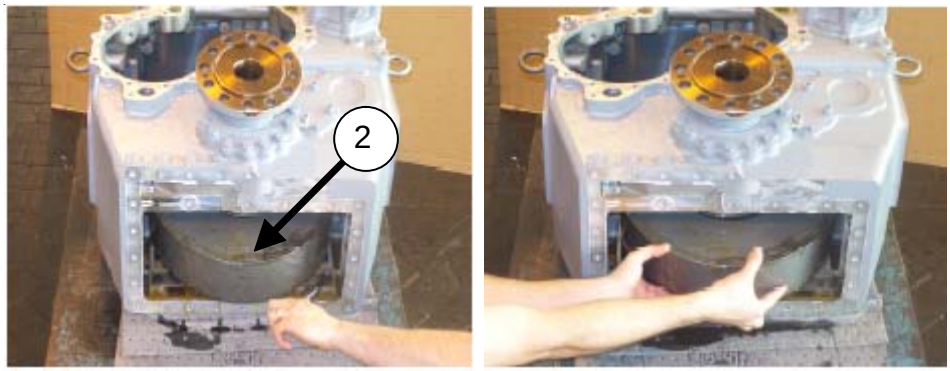
2. The transmission housing bottom cover is equipped with pusher screw to assist in the removal. Thread a M10-1.5 x 60 mm fully threaded cap screw (lubricated) into a pusher screw location to push the bottom cover away from the transmission housing.



DCP 0159 DCP 0161

Figure 51. Transmission Bottom Cover (1) Removal

3. Remove the retaining screws from the gear pan [2]. (2 of M10-1.5 x 25mm) Remove the gear pan.



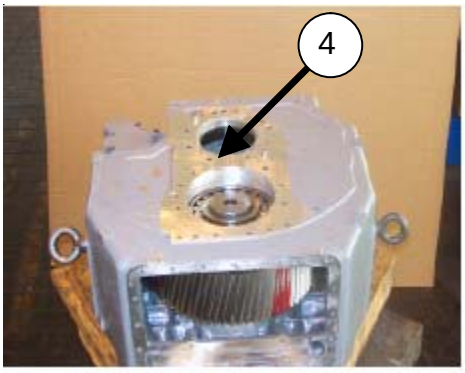
DCP 0162 DCP 0163

Figure 52. Gear Pan (2) Removal

Remove the Output Shaft

1. Place the transmission in an upright position. Be sure the transmission is supported securely. Remove the output seal carrier screws. This will allow the output shaft to slide a couple of inches rearward with the rear output shaft bearing.

2. Rotate the transmission to place the rear of the output shaft [4] at the top (output drive flange downward). Be sure transmission is supported securely with the output shaft in as vertical position as possible. Allow clearance below the output flange to allow approximately three inches of additional movement.

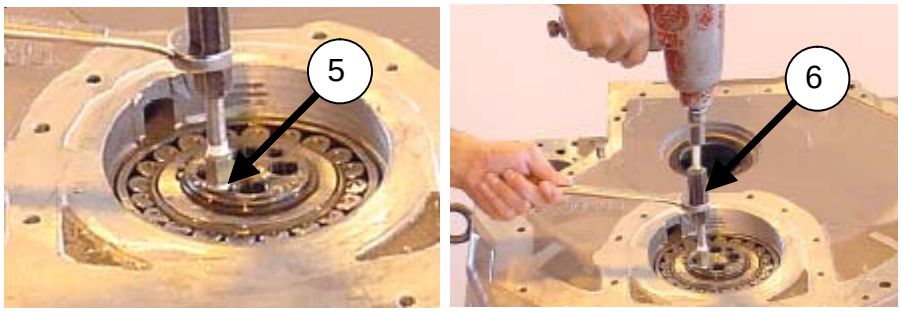


DCP 5692

Figure 53. Output Shaft (4)

3. Install the special tool (oil injection adapter tool) T-21482-8 into the end of the output shaft.

   a. Identify the location of the oil injection port [5]. The proper port is the threaded hole in the end of the shaft that contains a continuing passage through the shaft to the shaft tapered surface at the output gear.



MVC 845F MVC 845F

Figure 54. Oil Injection Port (5) Location and Oil Injection Adapter Tool (6) Installation

   b. Fill the shaft passage with SAE 40W oil.
   c. Wrap the threads of the oil injection adapter [6] with teflon sealing tape. Thread the oil injection adapter into the oil injection port in the end of the shaft.

4. Fill the oil injection adapter with SAE 40W oil. Lightly tap the oil injection adapter to remove air entrapped in the passage. Refill the passage with oil as required until the passage is filled and all traces of air are removed.

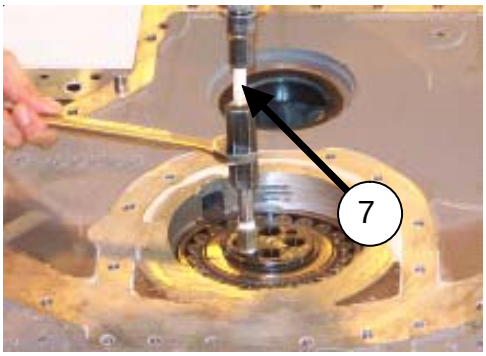
5. Wrap the threads of the injection adapter screw [7] with teflon sealing tape and install the screw into the oil injection adapter

6. Hold the oil injection adapter to prevent rotation during operation and use an impact wrench to drive the screw into the oil injection adapter until the output shaft and output gear tapered surfaces separate.

   If the shaft and gear do not separate during the initial injection, repeat steps 4 through 6.

⚠ WARNING

The gear and shaft will separate with extreme force, potentially causing great physical harm. Use EXTRA CAUTION and proper safety procedures. Place a support at the bottom of the output shaft to avoid the shaft from sliding further down.



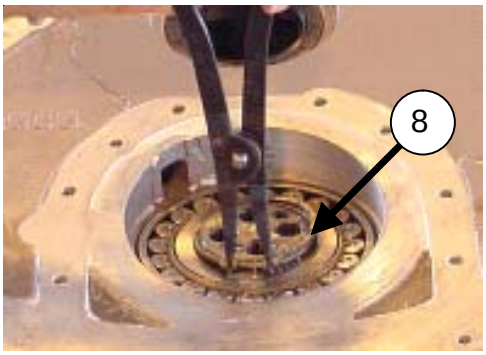
DCP 0950

Figure 55. Filling Oil Injection Adapter with Oil

7. Remove tool T4482-8 from the end of the shaft.

8. Remove the snap ring [8] from the shaft .

9. Install special tool T21482-8 to the port that intersects the bearing inner diameter.



MVC 846F

Figure 56. Internal Snap Ring Removal

10. Repeat steps 3b through 6 , which causes the bearing to expand, allowing the shaft assembly to drop free of the bearing bore. If the shaft and bearing do not separate, remove tool T21482-8, and rotate the transmission so the output flange is up. If the shaft does clear the bearing, raise the transmission housing off of the output shaft, being careful that the output gear, bearing or spacer does not slide from the housing

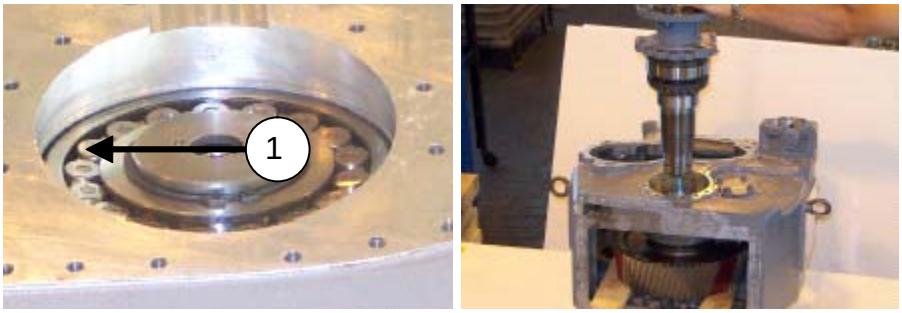
    NOTE: The spherical bearing cup and associated springs may come out of the housing when it is raised

11. If the bearing did not come off of the shaft, proceed with the next four steps. Support the transmission weight by the eye bolts in the output shaft. Raise the unit about two inches above the support table. Supply oil from an SKF pump into the port that feeds the bearing removal port.

12. Slowly apply high pressure oil to the port in the front of the output shaft.

13. Allow the transmission housing and output gear to lower as the high pressure oil expands the bearing [1] inner diameter, thus removing it from the shaft. Remove the hydraulic fitting and remove the bearing from the housing.

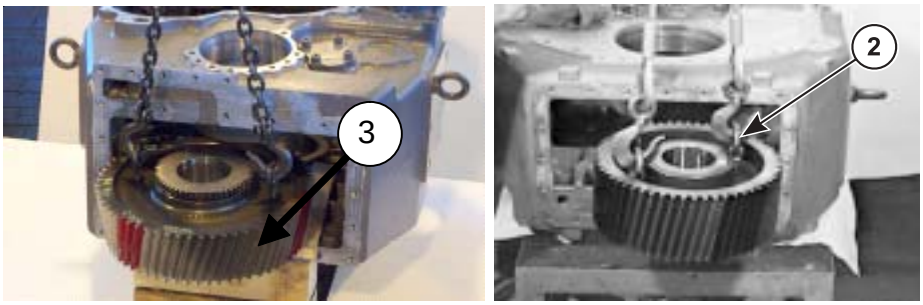
14. Raise the shaft from the housing and set aside.



DCP 5692 DCP 0963

Figure 57. Output Shaft Front Bearing Removal

15. Slide the output gear [3] out of the transmission housing until two M10-1.5 eyebolts [2] can be installed into the gear to allow it to be lifted with a crane. Remove the output gear from the transmission housing. Remove the bearing and spacer if not already done.

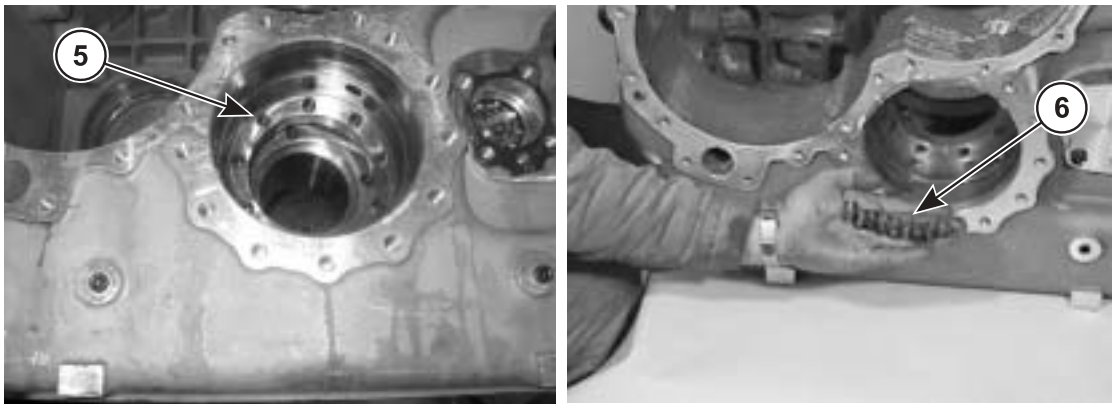


DCP 0956 136

Figure 58. Removing Output Gear From Transmission

16. Place the transmission in the upright position. Be sure transmission is supported securely.

17. Remove the coil springs [6] from behind the output shaft spherical roller bearing cup in the transmission housing [5] if they have not already been removed. Tag and number the coil spring to identify during assembly process.



060BE AR141

Figure 59. Output Shaft Spherical Bearing Coil Spring (6) Removal

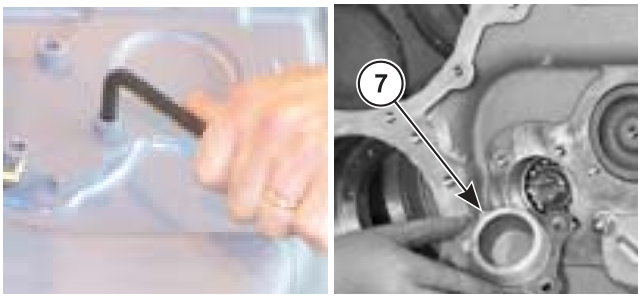
18. Remove the trailing pump drive gear from the output gear only if parts replacement is required.

Remove Trailing Pump and Shaft

Remove Pump/Cover and Shaft

1. Place the transmission in the upright position. Be sure transmission is supported securely.

2. Remove the trailing pump/cover [7] from the rear of the transmission.



DCP 0164 AR49 .

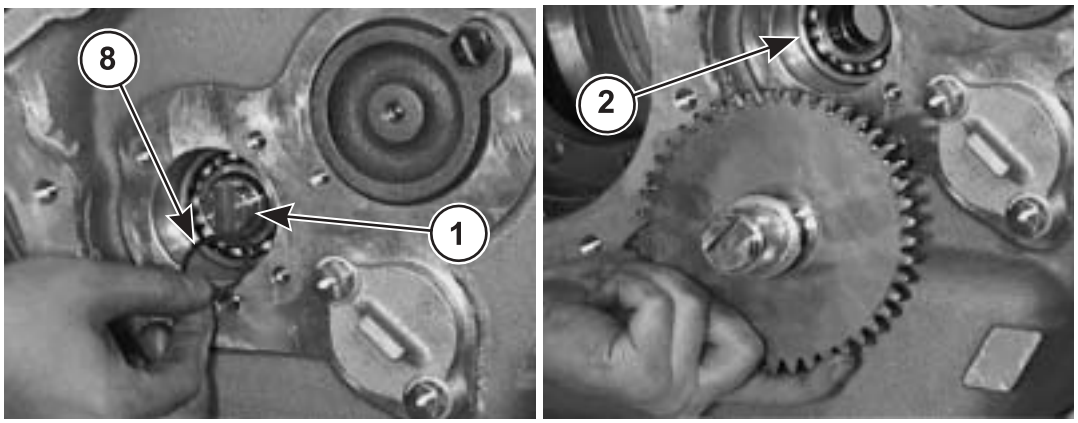
Figure 60. Trailing Pump Cover (7) Removal

3. Remove the external snap ring [8] from the trailing pump driven shaft.

4. Use special tool T-21482-17 to drive the shaft out of the bearings and into the housing.

⚠ CAUTION

Use extreme caution when removing the trailing pump drive shaft to prevent damage to the drive slot in the end of the shaft. The trailing pump drive shaft and gear are not serviced separately. The trailing pump drive gear and shaft are serviced as an assembly (as a single part number).

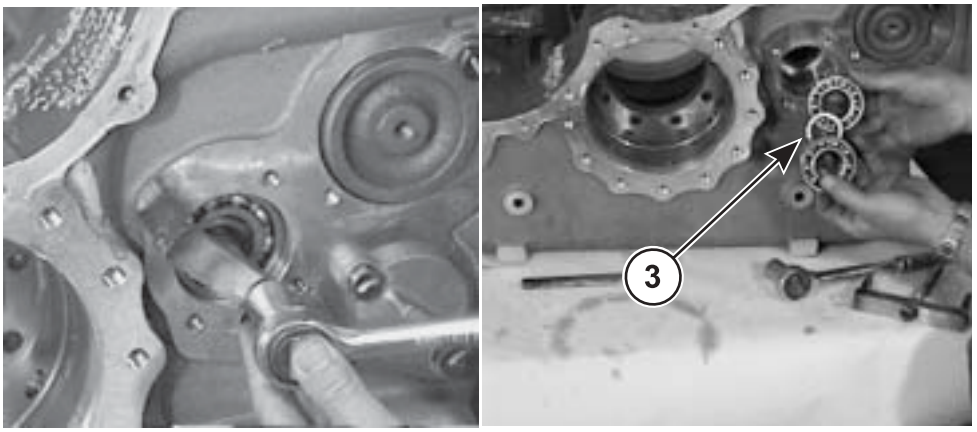


AR151 AR153

Figure 61. Trailing Pump Shaft Removal

Bearing Removal

Pull the trailing pump shaft bearings and spacer [3] out the back of the transmission housing. The spacer is located between the two ball bearings.



R156 AR157

Figure 62. Trailing Pump Shaft Bearing and Spacer (3) Removal

Front Bearing Cup Removal

NOTE: It may be possible to remove the bearing cups using a slide hammer puller.

To remove the Primary and Secondary shaft front bearing cup [3], if replacement is required, weld a bead midway around the circumference of the bearing cup with an electric welder, causing it to shrink for removal.

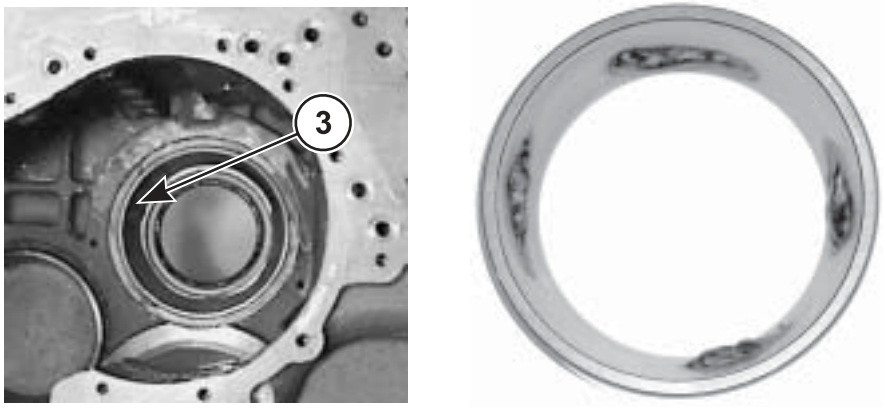


Figure 63. Input Shaft Front Bearing Cup (3)

Primary and Secondary Clutch Shaft, Output Shaft, Disassembly

Primary Clutch Shaft Disassembly

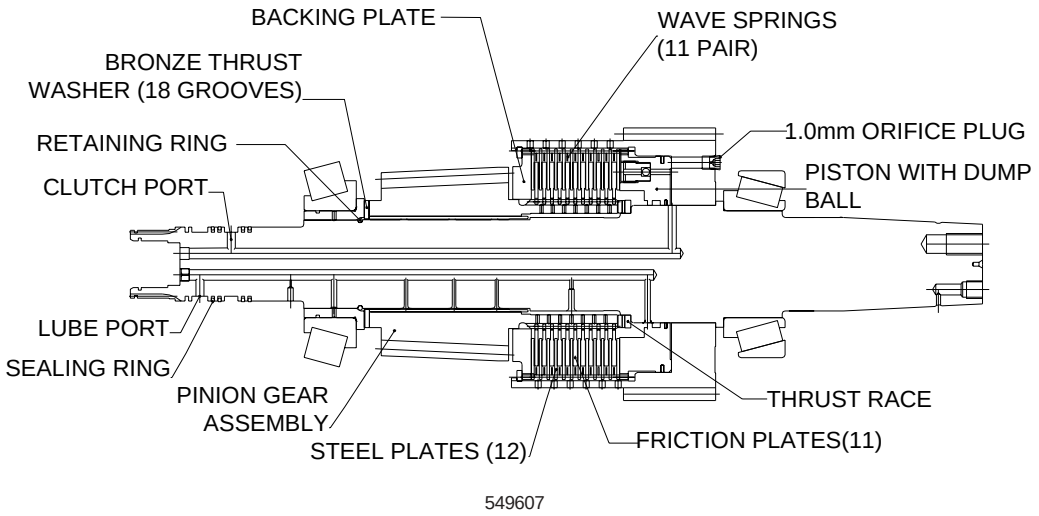
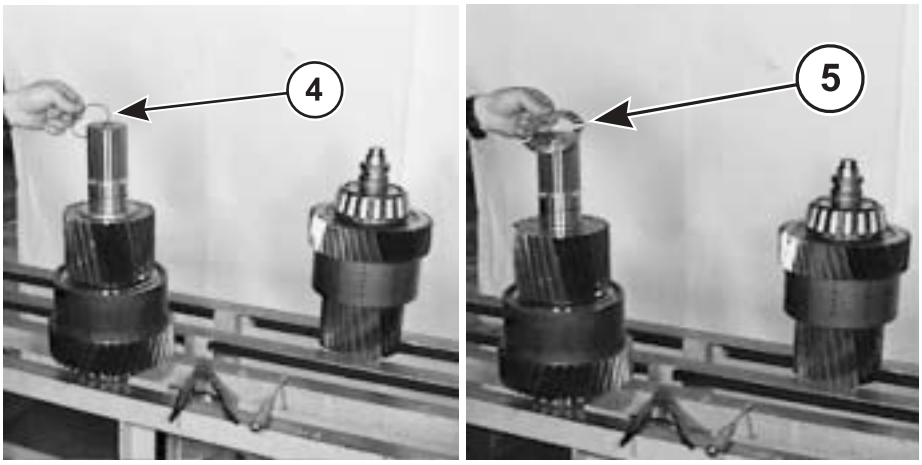


Figure 64. Primary Clutch Shaft Component Identification and Location

1. Position the shaft with the clutch sealing rings up.
2. Remove bearing from shaft if it did not remain in the housing.
3. Remove seal rings from shaft.
4. Remove round retaining ring [4] from the shaft.
5. Remove the bronze thrust washer [5].

   Note: The rear bronze thrust washer is equipped with 18 radial grooves (both sides) around the thrust washer for lubrication purposes.

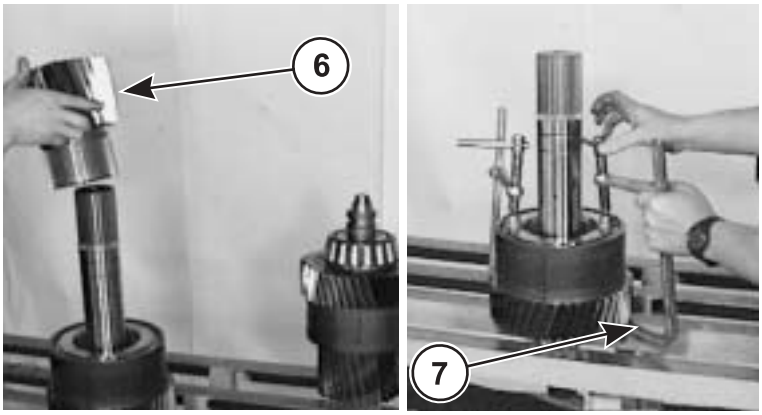


AR182 AR184

Figure 65. Retaining Ring (4) and Bronze Thrust Washer (5)

6. Remove the pinion assembly [6]. Tag the pinion assembly with identifying information. This will ensure the gear will be installed in the same location where it was removed.

7. Install two clamps [7] on the transfer gear and backing plate to compress the clutch wave springs. Compress the clutch until the internal retaining snap ring in the clutch can be removed.

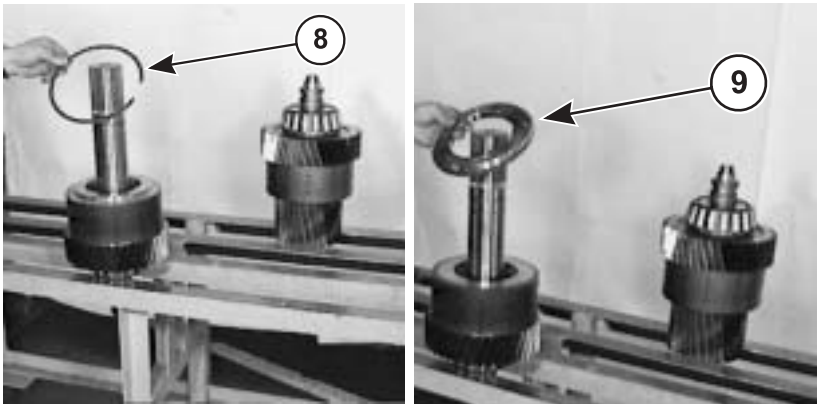


AR183-6557 AR186-6557

Figure 66. Pinion Assembly (6) and Clamping (7) Clutch Backing Plate

8. Remove the internal snap ring [8] from the clutch (retains the clutch backing plate). Remove the bar clamps from the clutch assembly.

9. Remove the clutch backing plate [9] from the clutch.

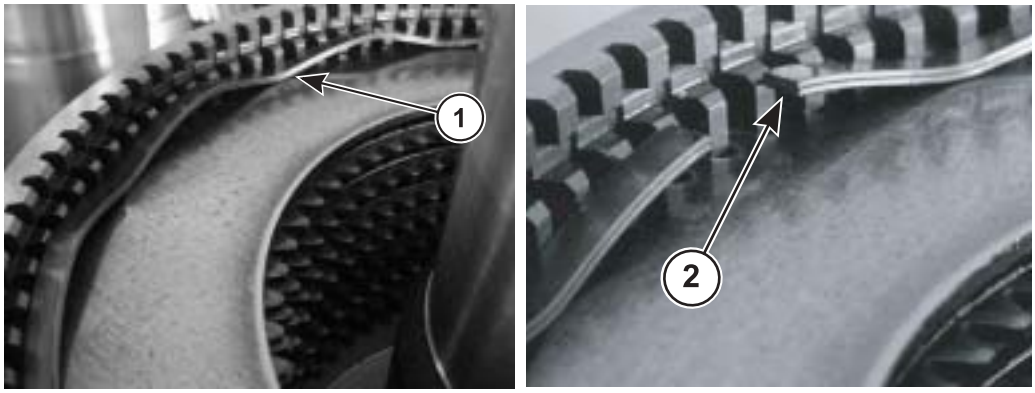


AR187 AR188

Figure 67. Internal Snap Ring (8) and Clutch Backing Plate Removal

10. Remove the steel clutch plates (quantity 12), the friction clutch plates (quantity 11), and the wave springs [1] (quantity 22).

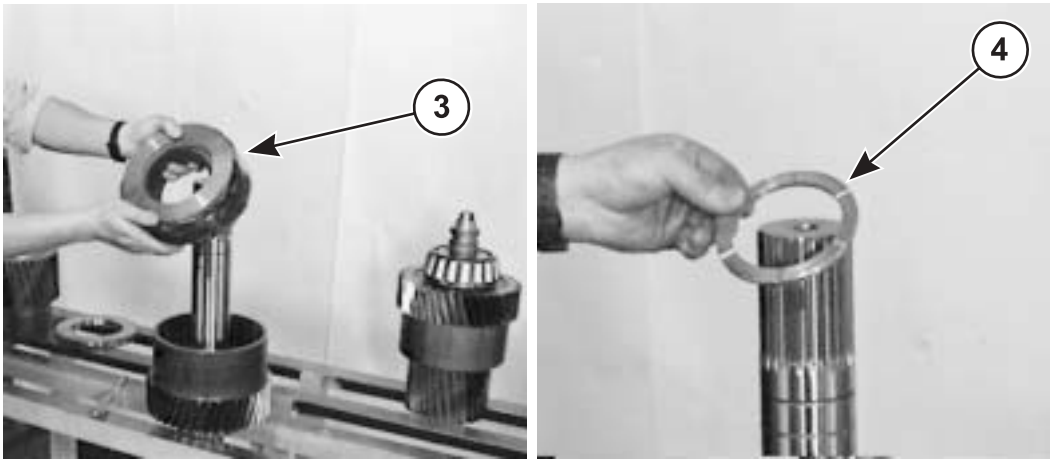
Note: Some early units use only a single wave spring between clutch plates. There are only 11 wave springs on these units.



ARMVC026FGS ARMVC028FGS

Figure 68. Clutch Wave Springs (1 and 2)

11. Remove the inner steel thrust washer and needle bearing



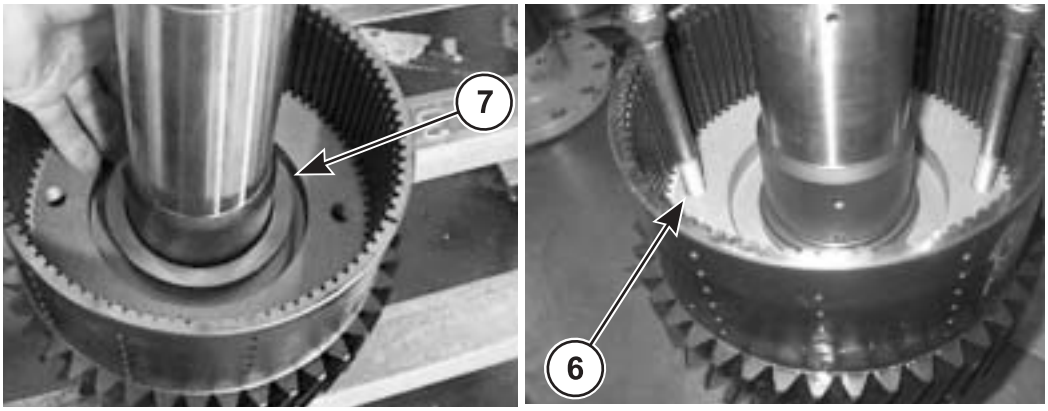
AR188C AR188D

Figure 69. Clutch Plates (3) and Bronze Thrust Washer (4)

12. Remove the steel thrust race from the clutch.

13. Remove the clutch piston from the clutch.

Note: If the clutch piston does not have threaded holes compressed air can be used to remove the piston.



191 6557066BE

Figure 70. Steel Thrust Race (7) and Clutch Piston (6) Removal

14. Invert the shaft, placing the input end of the shaft upward. Remove the shim and seal race if they have not already been removed.

15. Removal of the rear tapered roller bearing [1] requires destruction of the bearing to facilitate removal. **DO NOT** remove the rear bearing unless replacement is required.

RV SHAFT AND GEAR

Figure 71. RV Shaft and Gear

Secondary Clutch Shaft Disassembly

1. Position the shaft with the clutch sealing rings downward.

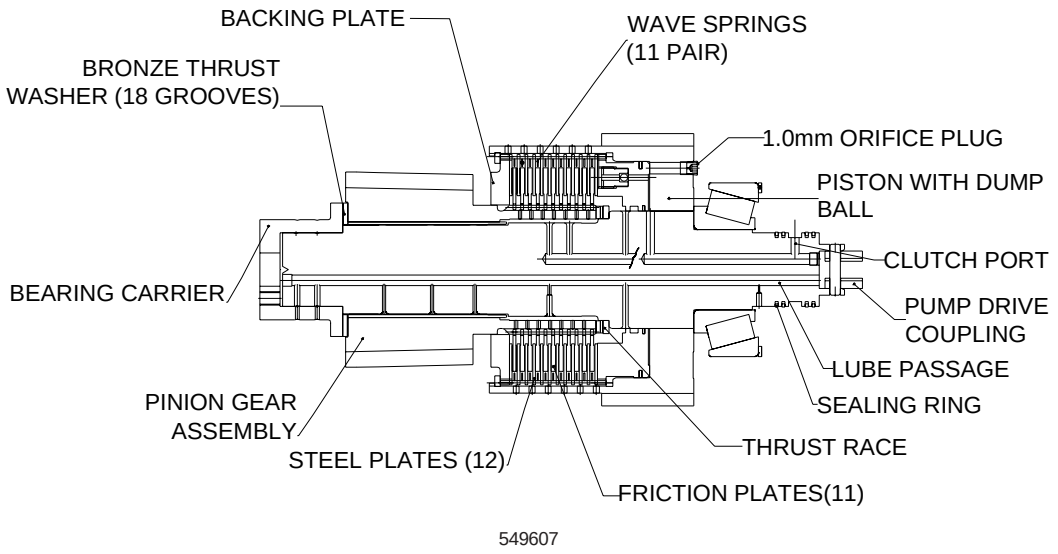


Figure 72. Secondary Clutch Shaft Component Identification and Location

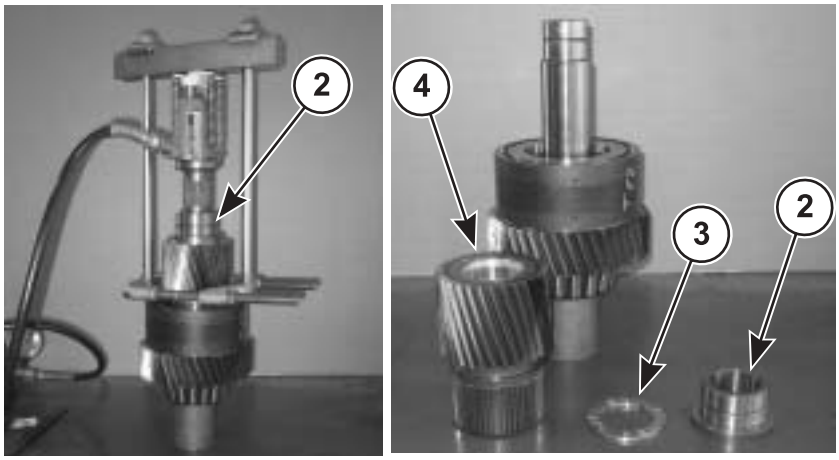
2. Remove the rear tapered roller bearing from the bearing carrier if it did not remain in the housing. The bearing is a slip fit on the bearing carrier. Remove the bearing carrier [2] from the end of the shaft. Use the pinion to pull the bearing carrier, bronze thrust washer and bearing carrier simultaneously. Tag the bronze thrust washer for identification purposes.

⚠ CAUTION

Use caution to prevent damage to bronze thrust washer when removing bearing carrier from the shaft assembly.

Note: The rear bronze thrust washer is equipped with 18 radial grooves (both sides) around the thrust washer for lubrication purposes.

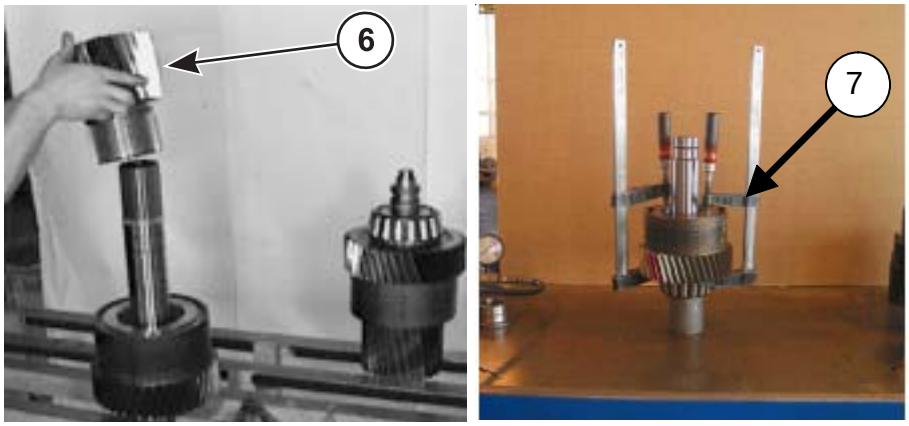
3. Remove the pinion/bushing assembly [4]. Tag the pinion assembly with identifying information. This will ensure the gear will be installed in the same location where it was removed.



1006BE 1007BE

Figure 73. Bearing Carrier (2), Pinion (4), and Thrust Washer (3) Removal

4. Install two clamps [7] on the transfer gear and backing plate to compress the clutch wave springs. Compress the clutch until the internal retaining snap ring in the clutch can be removed.

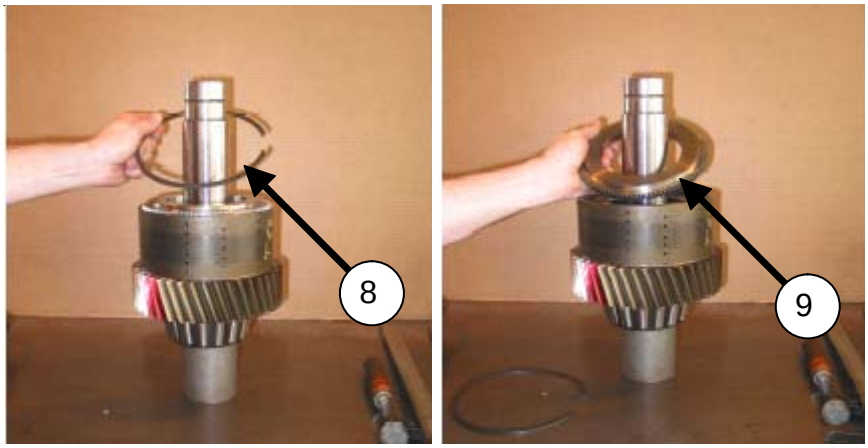


AR183 1009BE

Figure 74. Pinion Assembly (6) and Clamping (7) Clutch Backing Plate

5. Remove the internal snap ring [8] from the clutch (retains the clutch backing plate). Remove the bar clamps from the clutch assembly.

6. Remove the clutch backing plate [9] from the clutch.

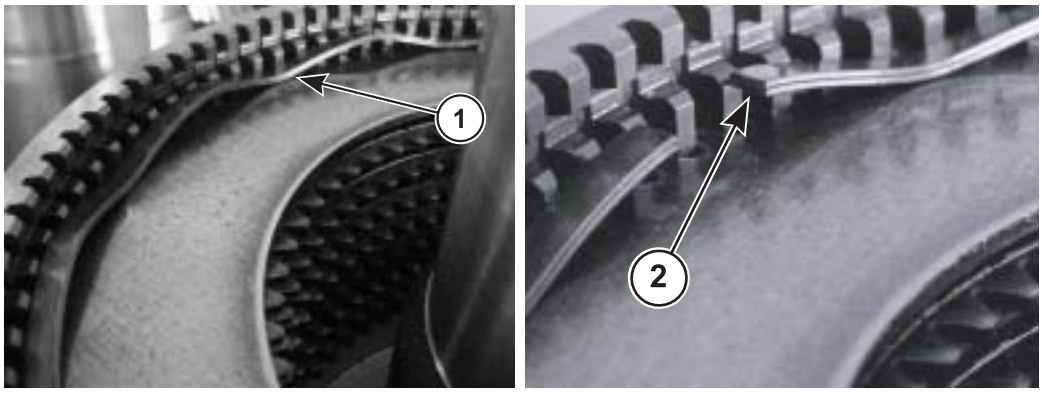


1012BE 1013BE

Figure 75. Internal Snap Ring (8) and Clutch Backing Plate Removal

7. Remove the steel clutch plates (quantity 12), the friction clutch plates (quantity 11), and the wave springs [1] (quantity 22).

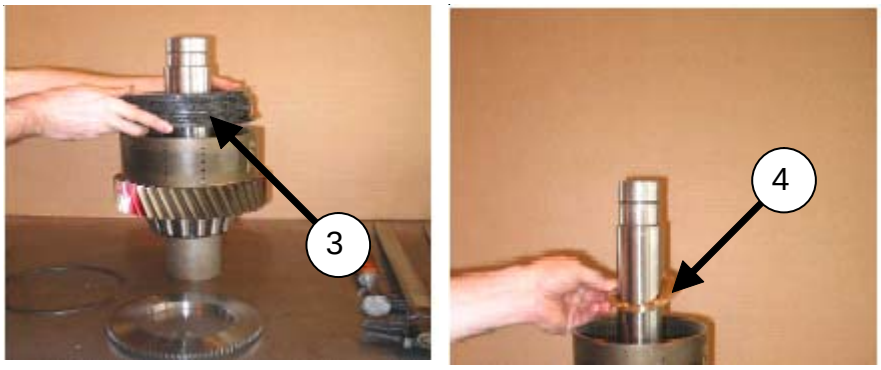
   Note: Some early units use only a single wave spring between clutch plates.



ARMVC026FGS ARMVC028FGS

Figure 76. Clutch Wave Springs (1 and 2)

8. Remove the Clutch plates [3] and then remove the steel thrust washer [4] and needle bearing.



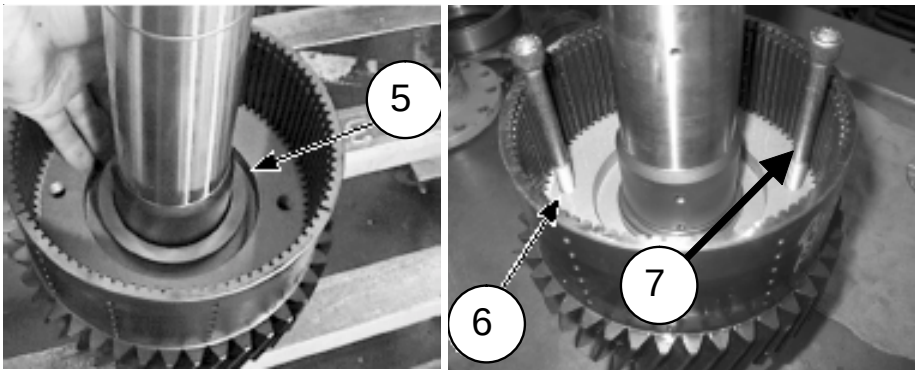
1014BE 1016BE

Figure 77. Clutch Plates (3) and Bronze Thrust Washer (4)

9. Remove steel thrust race [5] from the clutch.

10. Remove the clutch piston from the clutch.

Note: If the clutch piston does not have threaded holes compressed air can be used to remove the piston.

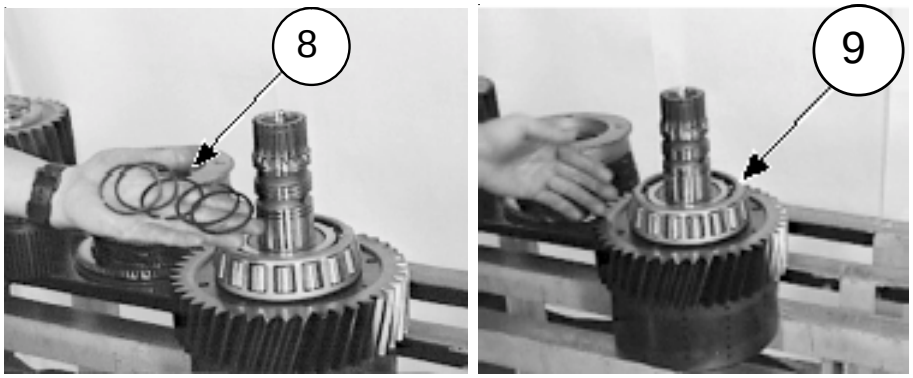


191 066BE

Figure 78. Steel Thrust Race (5) and Clutch Piston (6) Removal

11. Invert the shaft, placing the rear end of the shaft upward. Remove the clutch piston sealing rings [8] from the end of the shaft.

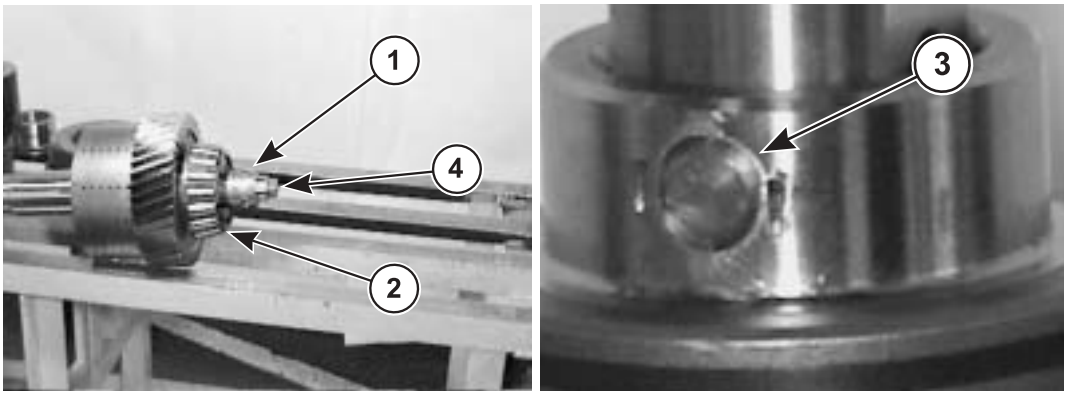
12. Removal of the rear tapered roller bearing [9] requires destruction of the bearing to facilitate removal. **DO NOT** remove the rear bearing unless replacement is required.



193 193A

Figure 79. Piston Sealing Rings (8) and Clutch Shaft Rear Bearing (9)

13. **DO NOT** remove the drive pin [3] from pump drive coupling [4] unless part replacement is required. The pump drive coupling pin is retained by staking in two locations at both ends of the pin.



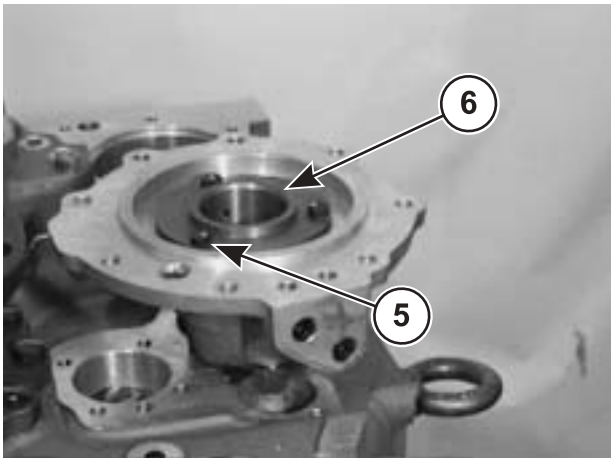
197 170

Figure 80. Piston Sealing Rings (1), Clutch Shaft Rear Bearing (2), and Pump Drive Pin (3)

Primary and Secondary Clutch Shaft Insert Removal

Note: Complete the following procedure only if part replacement is required. Secondary clutch shaft insert shown. The insert removal process is identical for primary clutch shaft insert.

1. Remove the screws [5] retaining the shaft rear cover insert [6].
2. Weld a washer in the bore of the steel insert with an arc welder.
3. Heat the aluminum cover to 120°C (250°F).
4. Pull the insert from the cover.



R283

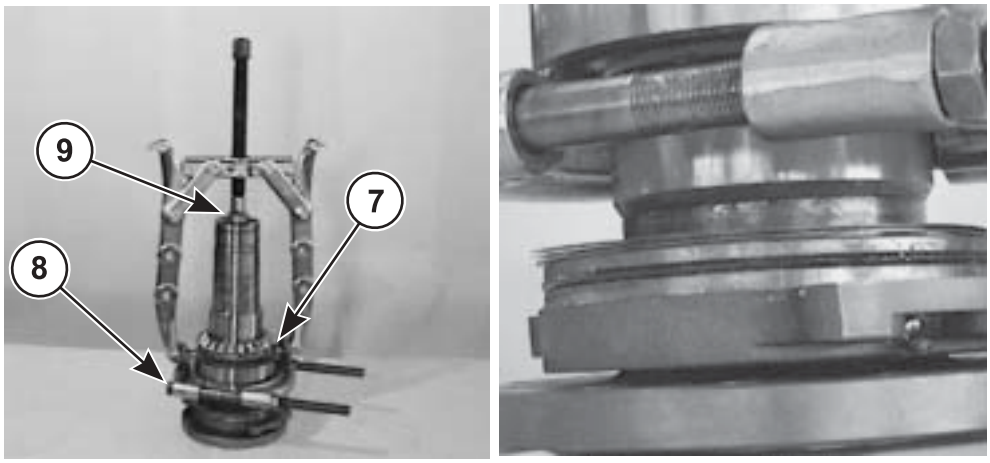
Figure 81. Clutch Shaft Insert (6)

Output Shaft Disassembly

1. Slide the oil seal carrier away from the output shaft bearings [7] until it contacts the output flange.

2. Place a split bearing puller [8] around the shaft between the output shaft seal carrier and the tapered roller bearing on the shaft assembly. The puller will remove both bearings simultaneously from the shaft. Place a shaft protector [9] between the puller assembly and the end of the shaft to protect the shaft end during disassembly.

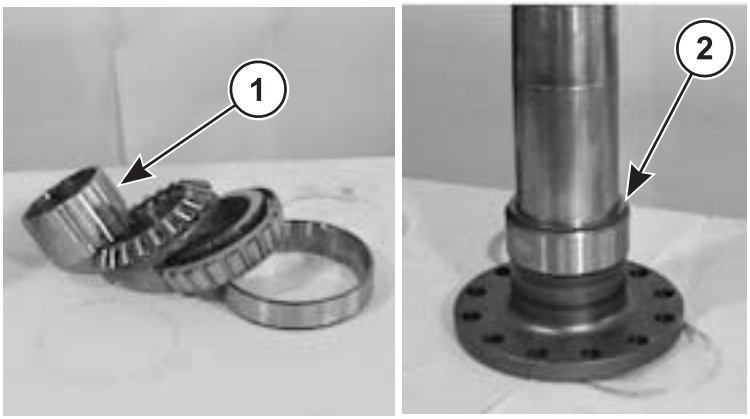
3. Ensure the bearing puller is properly placed to prevent damage to the bearings and other components of the shaft during disassembly.



AR214 R213

Figure 82. Output Shaft Bearing (7) Removal

4. Tag the components [1] with identifying information. Remove the output shaft seal sleeve [2] from the shaft.



AR215 AR220

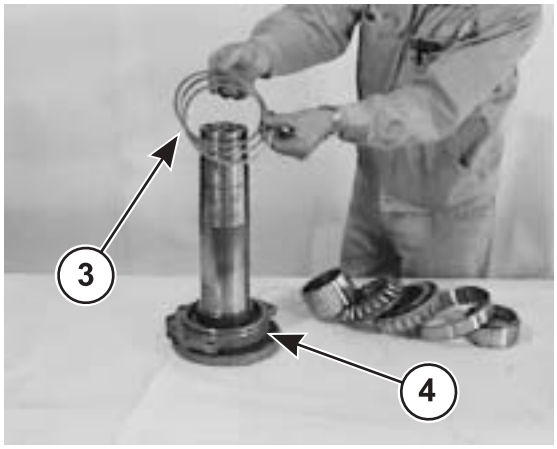
Figure 83. Output Shaft Components (1) and Seal Sleeve (2)

5. The seal sleeve [2] uses an O-ring on the inner surface, sealing the sleeve to the shaft. It may be necessary to destroy the seal sleeve to remove it.

AR216 ARMVC007FGS

Figure 84. Output Shaft Seal Sleeve (2)

6. Remove the bearing shims [3], and output seal carrier [4]. Tag the components with identifying information.



AR218

Figure 85. Output Shaft Bearing Shims and Seal Carrier (4)

Selector Valve Assembly -- Electric Valve

⚠ CAUTION

The steel ball is under pressure from the spring. Care must be taken when removing the cover and orifice plate to prevent loss of the steel ball.

1. Loosen and remove four of M8 x 25 socket head capscrews, and remove orifice plate cover and gasket.

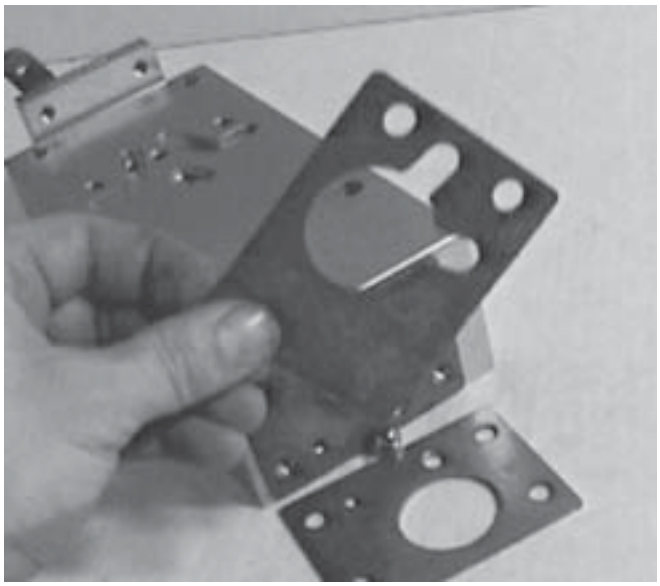


Figure 86. Removing Orifice Plate Cover Gasket

2. Remove orifice plate.

3. Remove steel ball and neutral pressure regulating spring.

4. Remove orifice plate gasket.

5. Remove the screen form the pocket and then remove rate-of-rise piston. Note that shims are located between the piston and springs.

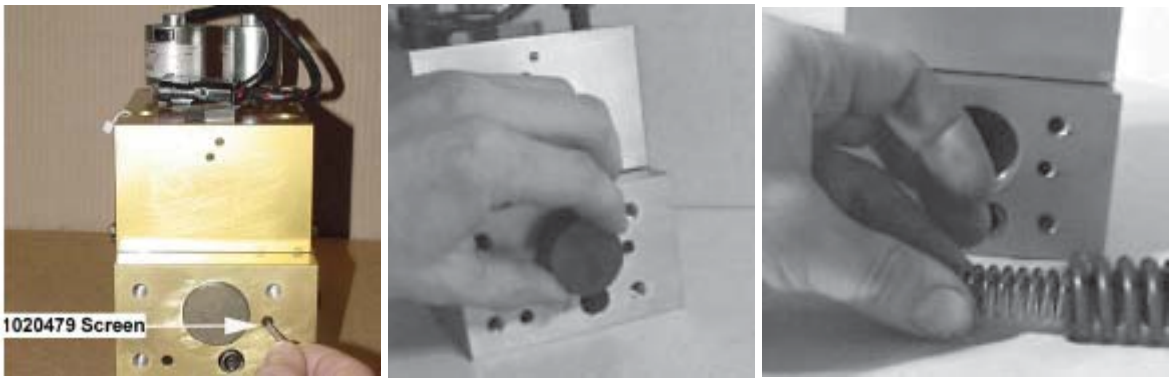


Figure 87. Screen (Left) Rate of Rise Piston (Middle) and Regulator Springs (right)

6. Remove pressure regulating springs.

7. Remove pressure regulating piston with an external retaining ring pliers.

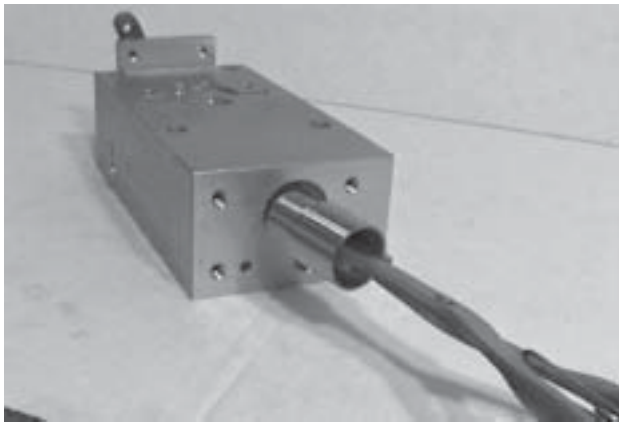


Figure 88. Removing Regulating Piston with Pliers

8. Remove external retaining ring from the lever end of the stem.

9. Loosen the clamping nut and remove the control lever from the stem. It may be necessary to splay the lever to be able to remove it. **DO NOT** apply any impact force to the lever, as the stem or dog-point setscrew might get damaged.

10. Remove the washer and spring from the stem.

11. Remove four of M8 x 25 socket head capscrews.

12. Remove the cover assembly with the gasket from the valve body.

13. Remove the O-ring and oil seal from the cover assembly.

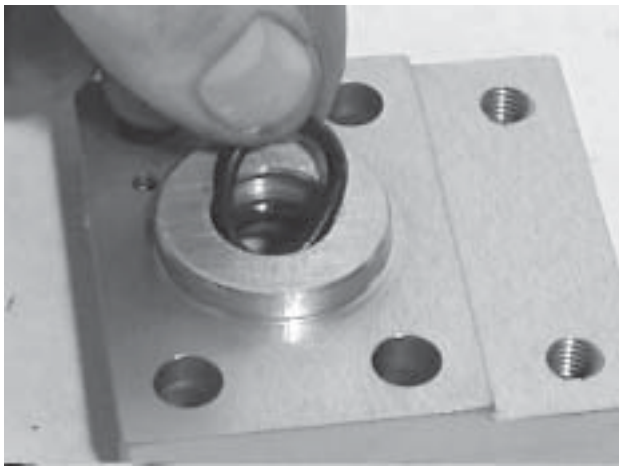


Figure 89. Removing O-ring from Cover

14. Remove the two electrical switches from the sides of the valve body and the two steel balls from each of the switch bores in the valve body (some models).

15. Remove the detent setscrew, spring, and steel ball from the valve body.

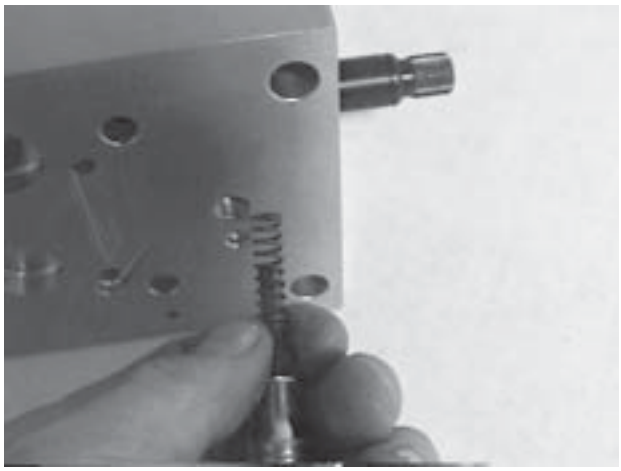


Figure 90. Removing Detent Setscrew and Spring

16. Remove the dog-point setscrew. Note that the setscrew is retained with MA908 threadlocker.

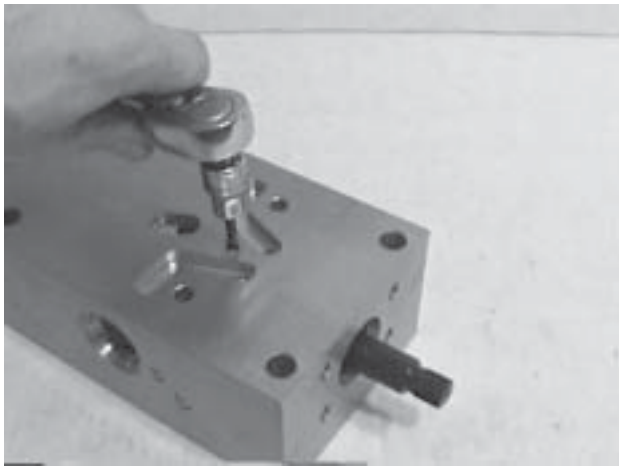


Figure 91. Removing Dog-point Setscrew

17. Remove the stem from the valve body partially.
18. Remove the thrust washer from the stem.

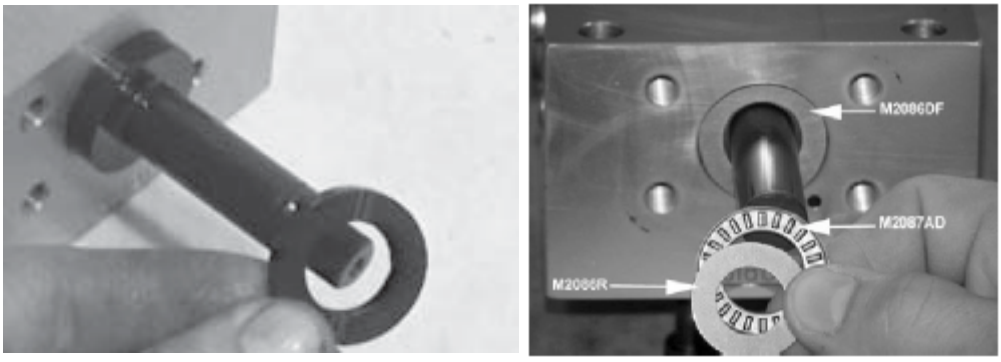


Figure 92. Removing Thrust washer

19. Remove the stem from the valve body.

20. Remove the roll pin (retains the shuttle ball seat) with a needle-nose pliers.

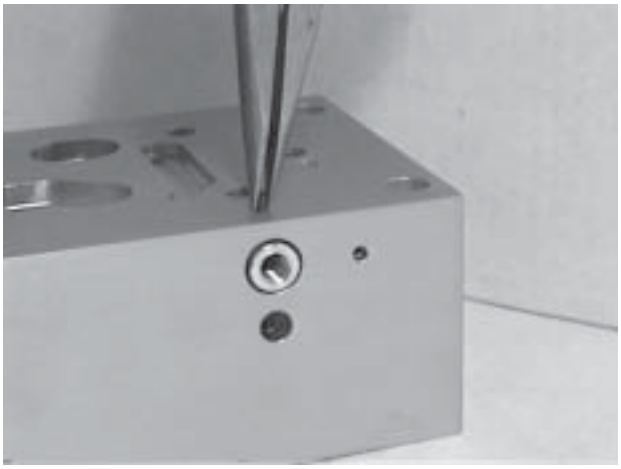


Figure 93. Removing Roll Pin Retaining Shuttle Seat

21. Thread a M8 x 1.25 screw (one of the cover screws works well) into the seat and remove it from the valve body.

22. Remove the shuttle ball from the valve body.

Disassembly of Upper Valve Body Half (electric section)

1. Remove the Weatherpak® connector from the valve body by sliding it in the direction of the opening in the shroud.

2. Mark the wires with the location letters that are on the Weatherpak® connector. Open the end of the Weatherpak® connector to allow removal of the pins and wires.

3. Remove the pins (for the wires of all but one solenoid) from the Weatherpak® connector using the extraction tool. The tool is Packard Electric P/N 12014012.

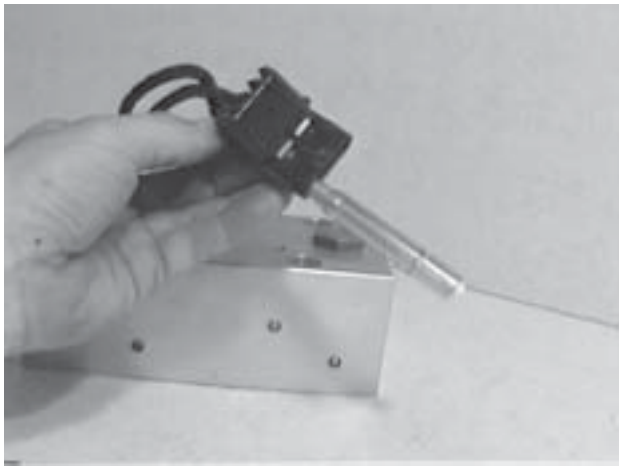


Figure 94. Removing Wires using Extraction Tool

4. Mark the two solenoids for location identification and remove them.

5. Remove the third (Neutral) solenoid (units with hydraulic lock) or plug (units without hydraulic lock).

6. Remove the filter screen from the valve body.

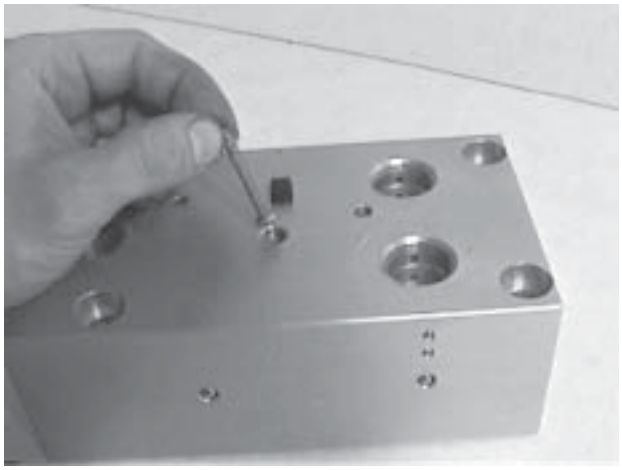


Figure 95. Removing Filter Screen

7. Remove the two socket head O-ring plugs from the bores in the end of the valve body.

8. Remove the two spools from the valve body.

9. Remove one dowel pin and spring from each of the spools (hydraulic lock units only).

10. Remove the spool return spring and dowel pin from the bottom of each of the spool bores in the valve body.

Disassembly of GP Control Valve with Electronic Interface

The GP Valve is made up of a non serviceable electronic interface, and two valve bodies with plugs and cartridges. O-ring kits are available for servicing the plugs and cartridges, however none of the cartridges are field serviceable beyond replacement of the o-rings. The later version (Assembly 1021658) of the hydraulic pressure regulator valve is serviceable, and contains an orifice/ filter plug, and a ball check valve assembly that are replaceable.

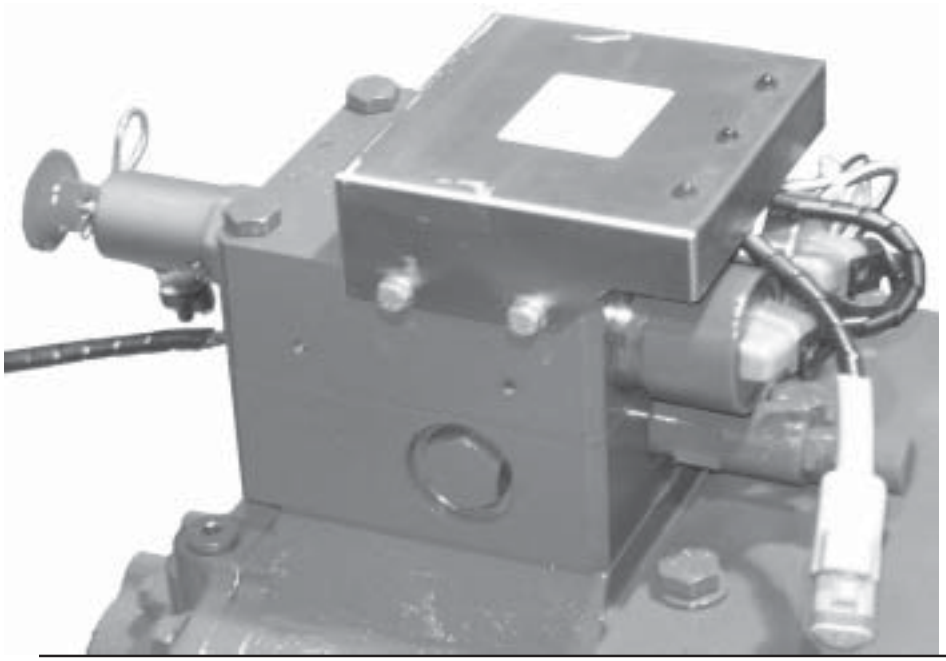


Figure 96. GP Valve Assembly mounted on Marine Transmission.

Disassembly

1. Disconnect the connectors at the proportional valves, the neutral switch, and the temperature sensor (if equipped), and loosen the four M6-1.0 capscrews that retain the Electronic Interface Module to the Hydraulic portion of the valve assembly. If the Electronic Interface is not being replaced, it can be set aside without disconnecting the remaining wires from the installation.

Figure 97. Electronic Profile Module (typical)

2. Remove the six M10-1.50 x 70 capscrews that retain the top valve body assembly to the transmission, and remove the top valve body assembly with gasket (if not previously removed).

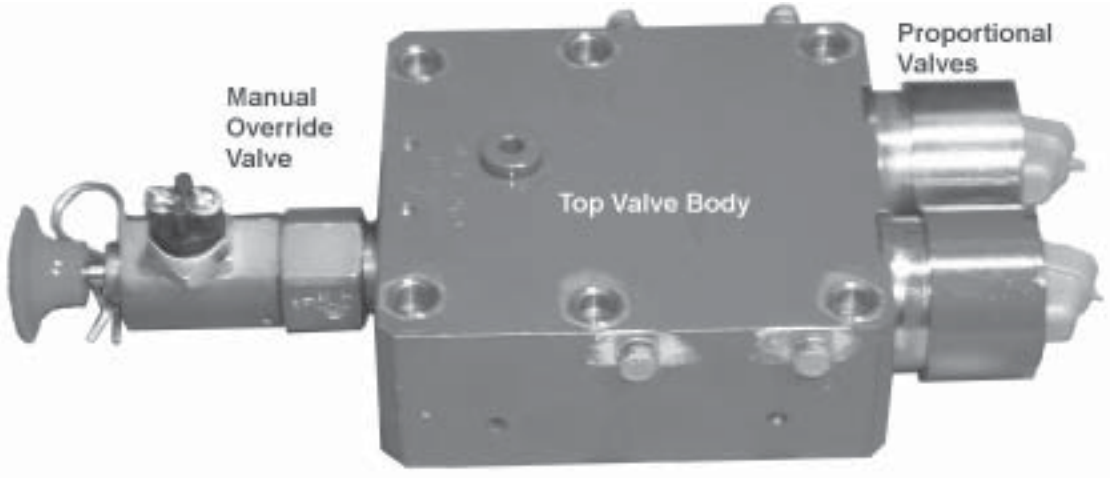


Figure 98. Top Hydraulic Valve Body Assembly

3. Remove the four capscrews that retain the main regulator valve assembly to the transmission housing or ditch plate, and remove the valve assembly and gasket.

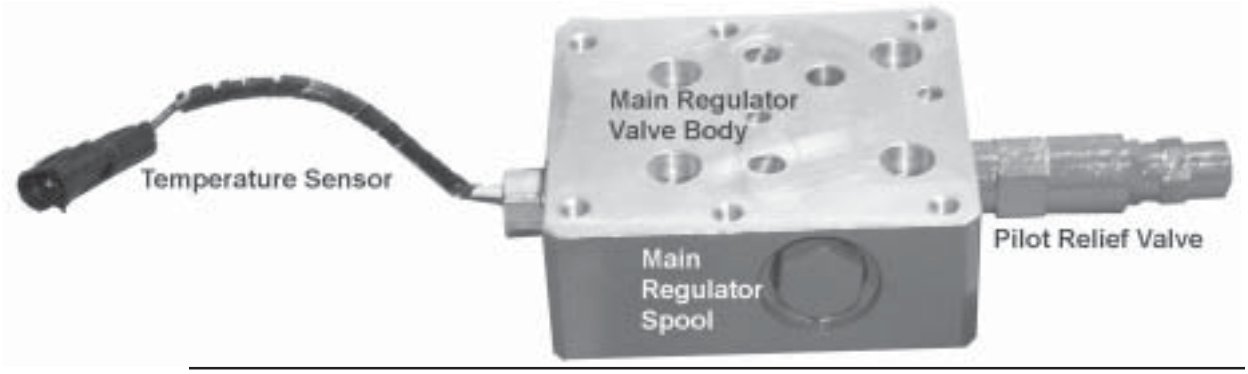


Figure 99. Main Regulator Hydraulic Valve Assembly (1020729)

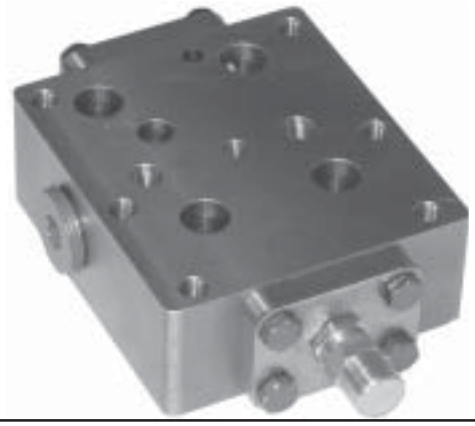


Figure 100. Main Regulator Hydraulic Valve Assembly (1021658)

4. Remove the Manual Direction Control Valve with switch or the Plug Assembly from the Top Valve Body.

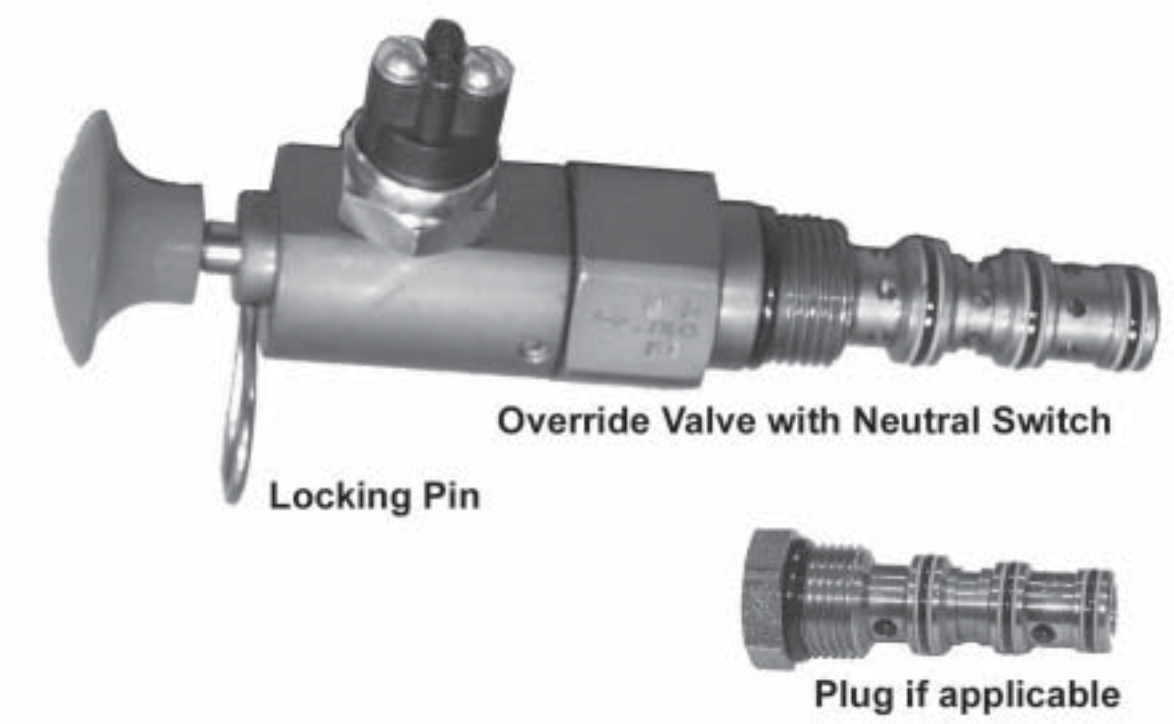


Figure 101. Manual Direction Control Valve or Plug

5. Remove the M6-1.00 x 16 Allen head capscrew, the retaining plate, and the proportional Valve Cartridges from the Top Valve Body. A slight rotating motion while pulling will help to with the removal of the valves.

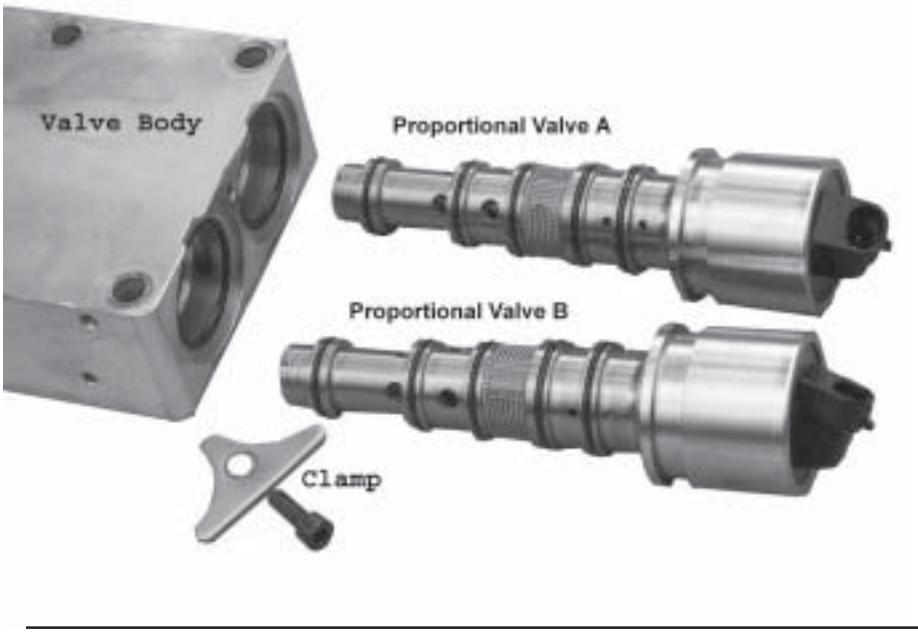


Figure 102. Remove Proportional Valve Cartridges

6. **Valve Assembly 1020729:** Remove the Main Pressure Regulator Pilot Relief Valve and Main Valve from the Main Regulator Valve body.

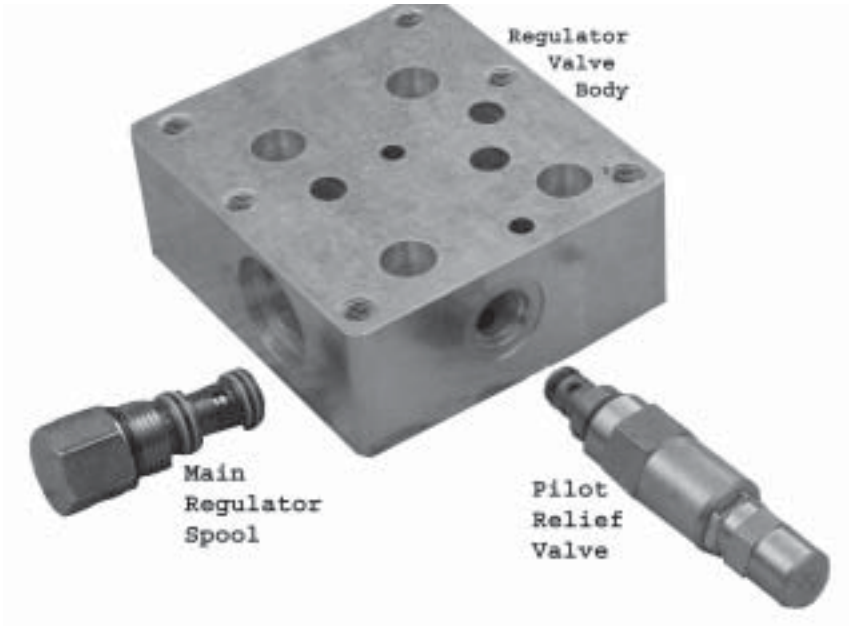


Figure 103. Remove Main Pressure Regulator Valve Components

6. **Valve Assembly 1021658:** Remove the Main Pressure Regulator from the Main Regulator Valve body.

   A. Remove the regulator adjusting screw cap, and loosen the jam nut.

   B. Turn the adjusting screw counter clockwise to reduce the spring load on the valve.

   C. Evenly loosen the four M-8 x 25 capscrews, and remove the cover assembly and gasket, followed by the spring(s) and spool.

   D. Remove the four M-8 x 20 capscrews, and remove the cover and gasket.

   E. Remove the orifice and screen assembly for cleaning.

   F. Remove the ball check assembly only if necessary. Removal will require destruction and replacement of the assembly.

Figure 104. Remove Main Pressure Regulator Valve Components

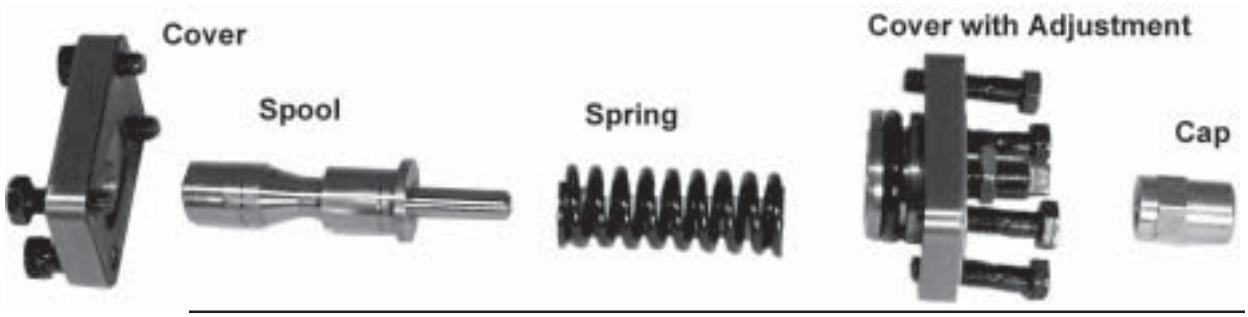
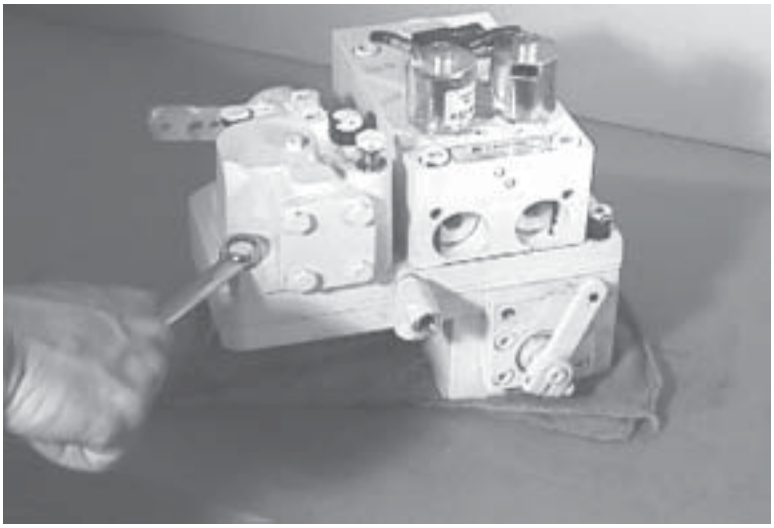


Figure 105. Remove Main Pressure Regulator Valve Components

Trolling Valve (Optional Equipment)

1. Remove the trolling valve from the ditch plate.



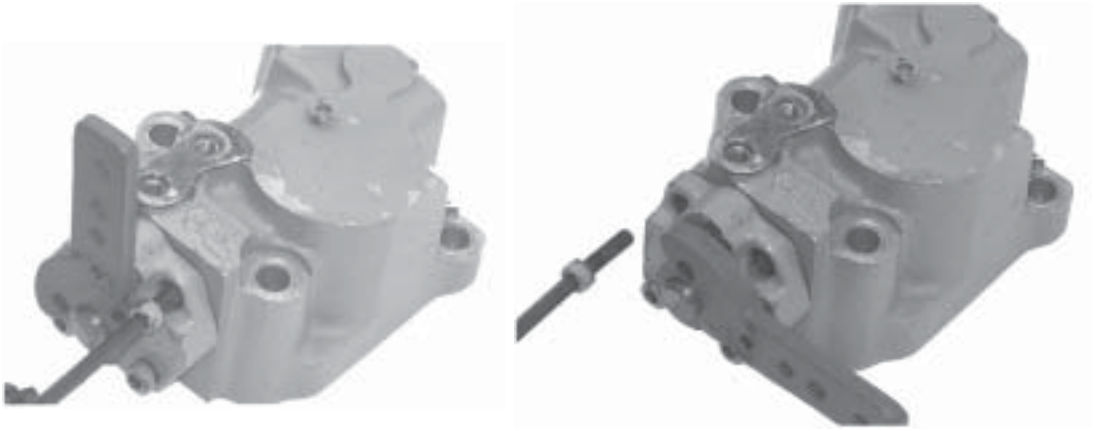
168753c3

Figure 106. Remove trolling valve

2. Remove upper valve body half from the ditch plates.

3. Remove the ditch plates and lower valve body half from the transmission.

4. Rotate the trolling valve lever to the minimum trolling pressure position. Remove the upper-right-hand cover attaching screw. Rotate the trolling valve lever to the detent position.



1256b 1257b

Figure 107. Remove cover screws

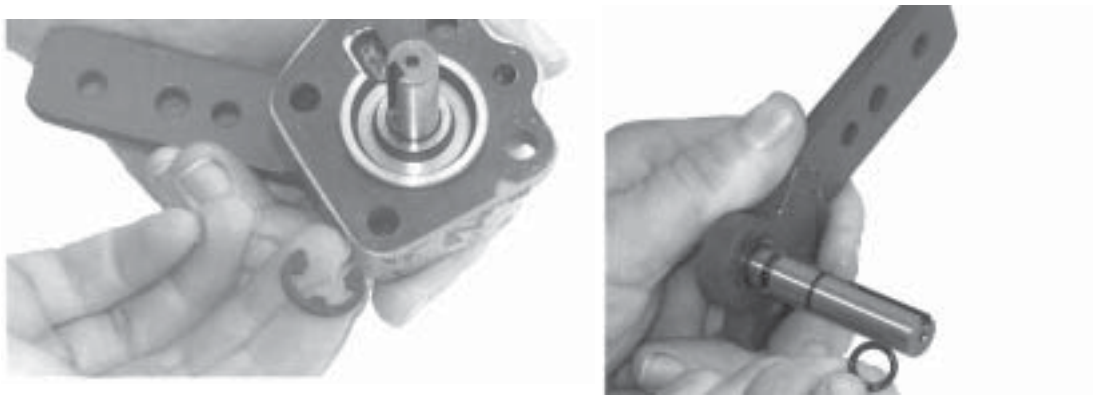
5. Remove the three remaining cover attaching socket head capscrews. Note the long capscrews are used in the bottom screw holes.

6. Remove the cover and shaft assembly and cover gasket. The shaft will be removed with the cover because of the shoulder in the shaft. Remove the detent spring and detent ball from the pocket in the cover assembly.

1261b 1263b

Figure 108. Remove cover and detent spring

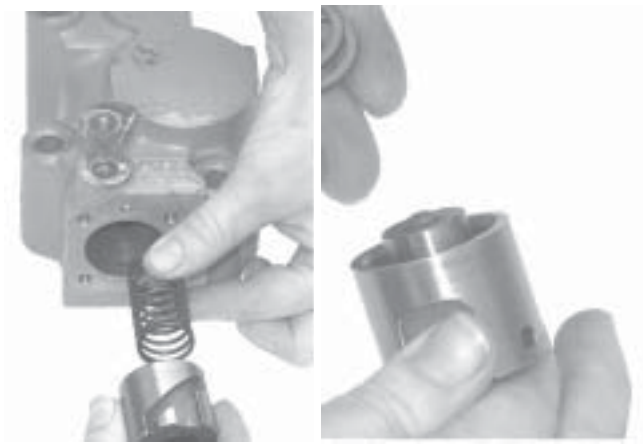
7. Remove the “E” retaining clip from the shaft. Slide the shaft out of the cover. Remove the O-ring from the groove in the shaft.



1268b 1270b

Figure 109. Remove clip and o-ring

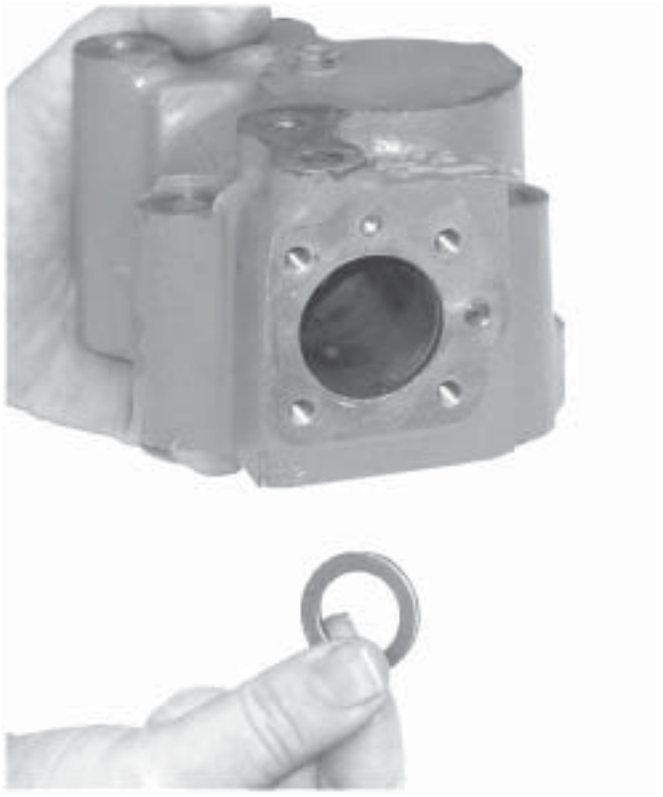
8. Remove the piston assembly and large diameter spring from the bore of the valve. Remove the shim(s) from the bore of the piston assembly.



1273b 1274b

Figure 110. Remove piston, springs, and shims

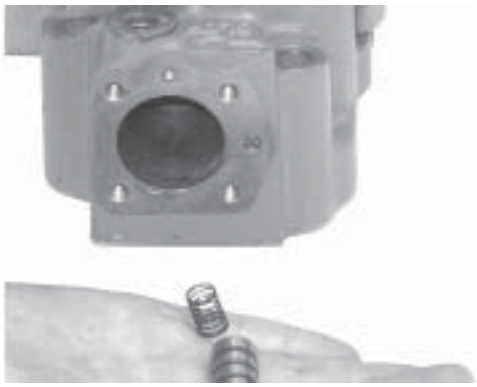
9. Remove the washer from the bore of the valve.



1277b

Figure 111. Remove washer

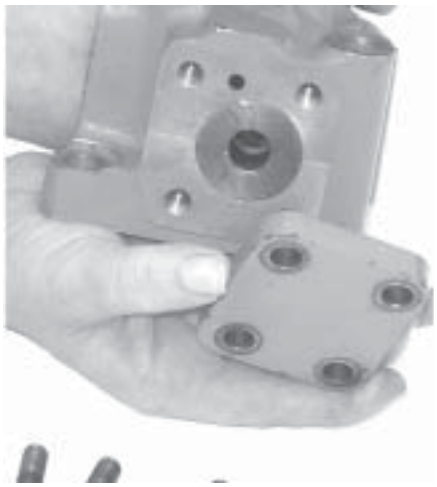
10. Remove the flow control piston and spring from the valve bore.



1278b

Figure 112. Remove flow control piston and spring

11. Remove the end cover (attached with four hex head capscrews) and gasket from the valve.

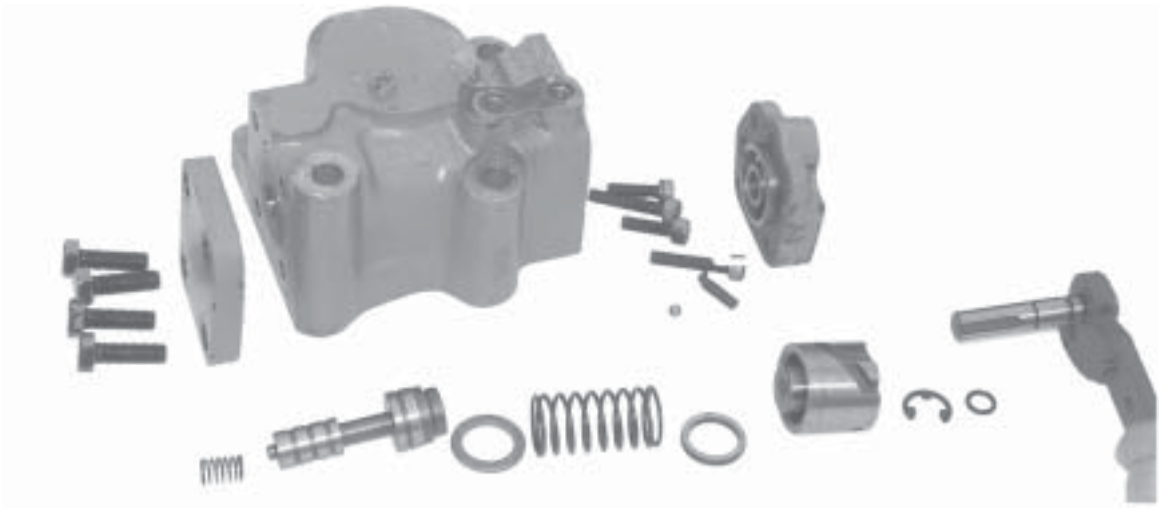


1281b

Figure 113. Remove end cover

12. Remove the two bushings and internal retaining ring from the valve only if replacement of parts is necessary. The bushings are a tight fit in the bore of the valve. Note that the bushing with one groove in the outside diameter is adjacent to the retaining ring in the valve body bore.

13. Remove the PT pipe plugs from the valve to clean the oil passages inside the valve.



1288b

Figure 114. Valve parts

Cleaning and Inspection

Cleaning

Note: Replace all oil seals, gaskets, O-rings, piston rings, seal rings and snap rings as a part of any maintenance or overhaul procedure. Replace shims that are damaged or destroyed in disassembly.

- ❑ Clean all parts using EPA/OSHA approved solvents or by steam cleaning. Parts must be dried and oiled immediately to prevent corrosion.
- ❑ Examine all parts carefully for grit, dirt and abrasives and reclean them if necessary.
- ❑ Clean all oil passages by working a piece of wire back and forth through the passages and then flushing them with cleaning solvent.
- ❑ Use clean solvent to flush oil pumps and valves.
- ❑ Flush all hoses, tubing and coolers, particularly if the unit is being disassembled because of an internal failure.
- ❑ De-burr the housing and bearing carrier with a stone or file in the vicinity of all pusher screw locations.

Cleaning Bearings

DO NOT remove grease in which new bearings are packed. Thoroughly wash bearings that have been in service. Soak bearings in solvent if they are particularly dirty or filled with hardened grease.

⚠ CAUTION

Never dry bearings with compressed air. DO NOT spin non-lubricated bearings. Oil bearings with SAE 10 engine oil immediately after cleaning. Oil bearings before inspection.

Preventing Dirt from Entering into Bearings

Dirt and grit in bearings are often responsible for bearing failure; consequently, it is important to keep bearings clean. **DO NOT** remove grease from new bearings. Keep the wrapper on new bearings until they are installed. **DO NOT** expose clean bearings if they are not to be assembled at once. Wrap them with a clean lint-free cloth or paper to keep out dust.

Previously Sealed Joints

- ❑ For previously sealed joints, scrape surfaces to remove old gasket material or silicone.
- ❑ Clean surfaces with solvent to remove oil and grease residue.
- ❑ Test for clean surfaces by applying a few drops of cool water to the surfaces. Parts are sufficiently clean if water covers the surface in a film. If the water puddles or forms beads, use fresh solvent and reclean.

Inspection

Housings, Cast Parts, and Machined Surfaces

- ❑ Replace cast parts or housings that are cracked.
- ❑ Inspect bores for wear, grooves, scratches and dirt. Remove burrs and scratches with crocus cloth or soft stone. Replace deeply grooved or scratched parts. **DO NOT** remove excess material by sanding. This will cause loss of press of bearings or races.
- ❑ Inspect oil passages for obstructions. If you find an obstruction, remove it with compressed air or work a wire back and forth through the passage and flush it with solvent.
- ❑ Inspect machined surfaces for burrs, scratches, nicks and foreign matter. If you cannot remove the defect with crocus cloth or a soft stone, replace the part.
- ❑ Inspect ground tapers for burrs or nicks. If you cannot remove the defect with a soft stone, replace the part.
- ❑ Inspect ground tapers for scratches, galling or scoring damage. If you find any of these defects, replace the part.
- ❑ Inspect threaded openings for damaged threads. Chase damaged threads with a tap of the correct size.
- ❑ Inspect studs for damaged threads and looseness. Replace defective studs.
- ❑ Inspect dowel pins for wear or damage. Replace defective dowels. This applies where a matched set of parts is not involved.
- ❑ Inspect dowel pin holes for wear due to movement between mating parts. If a dowel pin hole is worn, re-bore and sleeve the hole when possible. Otherwise, replace the parts. This applies where a matched set of parts is not involved.

Valve Seats

Inspect valve seats for burrs, nicks and scratches. If you cannot remove these defects with a crocus cloth, replace the part. Check to see that the valve is seating properly after reworking the valve seat.

Bearings

- ❑ Inspect bearings for rotation roughness. Replace the bearing if the rotation is rough.
- ❑ Inspect bearings for corrosion, and for wear indication on balls or rollers. Inspect for scored, scratched, cracked, pitted or chipped races. If you find one of these defects, replace the bearing.
- ❑ Inspect bearing bores and shafts for grooved, burred, or galled conditions that would indicate the bearing has been turning in its housing or on its shaft. If you cannot repair the damage with a crocus cloth, replace the part.

Bushings and Sleeves

Inspect bushings for size and out-of-roundness. Inspect for scores, burrs, sharp edges, and evidence of overheating. Remove scores with a crocus cloth. If the bushing is out-of-round, deeply scored, or excessively worn, replace it.

Thrust Washers and Spacers

Inspect thrust washers for distortion, scores, burrs and wear. Rework or replace any defective thrust washers or spacers.

Gears

- ❑ Inspect gears for scuffed, nicked, burred or broken teeth. If you cannot remove the defect with a soft stone, replace the gear.
- ❑ Inspect gear teeth for wear that may have destroyed the original tooth shape. If you find this condition, replace the gear.
- ❑ Inspect thrust faces of gears for scores, scratches and burrs. If you cannot remove these defects with a soft stone, replace the gear.

Splined Parts

Inspect splined parts for stripped, twisted, chipped or burred splines. Remove burrs with a soft stone. Replace the part if other defects are found.

Springs

Inspect springs for broken or distorted coils. Replace the spring if either of these defects is found.

Flexible Hoses

Inspect all flexible hoses for cracks and sponginess. Replace damaged hoses.

Clutch Plates

Inspect clutch plates for signs of overheating, pitting, or excessive wear of the friction and splined surfaces. Replace the clutch plates if one of these defects is found. Refer to wear limits in Description and Specifications.

NOTES

Assembly

Note: Photos are for illustration purpose of the procedure and may not appear to be consistent with the previous assembly steps.

General

During service of this unit, all O-rings, gaskets and seals **must be** replaced.

Refer to cleaning and inspection information in this manual prior to assembly. It is good practice to compare the new parts with those being replaced during the assembly process (to make sure you don't mistake the quantity or size).

Flat washers are used under all fasteners where the head of the fastener contacts an aluminum surface.

Unless otherwise specified, all torque values listed are for capscrews that have been lubricated on the threads and contact surfaces.

Pipe threads called out as PT on drawings and in this text are different from NPT threads. PT threads and NPT threads are NOT interchangeable. Adapters are available from several manufacturers to convert PT threads to NPT threads.

Where grease is specified, use a lithium based grease (NLGI 2).

Submerge all new clutch friction plates in clean transmission oil for a minimum of one hour prior to installation.

This transmission uses liquid sealer in many locations. The approved sealant is Loctite® 518 (MA1015), applied per S774 (a thin layer of sealant is all that is required), with Loctite® Primer N (MA1012). Avoid getting sealant into the O-ring counter bores.

This transmission uses thread lockers MA908 and MA1007 at specified capscrew locations.

Note: In the discussion that follows, the input and output side of the transmission is the front. Left and right sides are determined by facing the unit from the rear toward the front.

⚠ CAUTION

Appropriate eye protection must be worn during transmission assembly. To avoid personal injury, proper safety equipment must be used during installation of any heated bushings, bearings and other components.

Primary Clutch Shaft Assembly

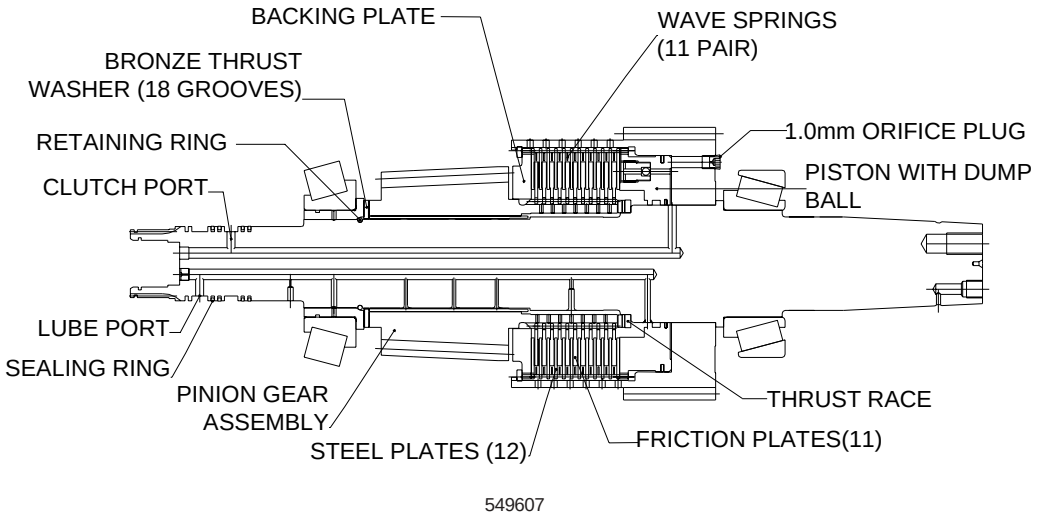


Figure 115. Primary Clutch Shaft Component Identification and Location

1. Inspect the clutch piston dump valves [1] for proper operation. Be sure the dump valve balls are free to move. The clutch piston dump valves are not serviced separately.

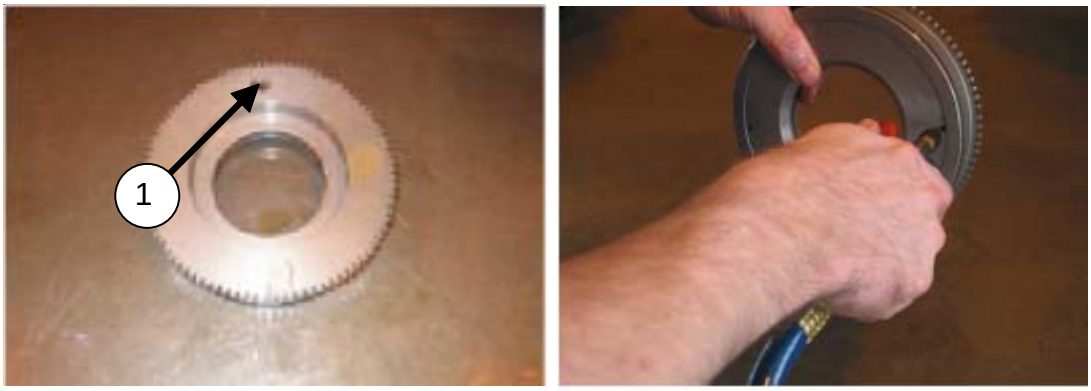


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Figure 116. Clutch Piston with Dump Balls (1)

2. Replace the clutch piston seals [2]. Lubricate the clutch piston sealing rings before installing the piston into the clutch housing.

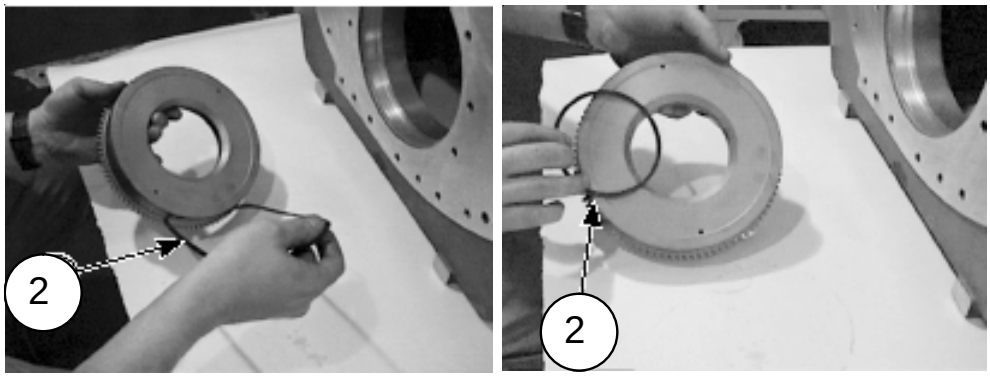

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Figure 117. Installing Cutch Piston Seals (2)

3. Lubricate the clutch piston bore with a thin film of grease. Install the piston into the clutch housing. Gently push the piston by hand until it is fully engaged into the clutch [5].

Note: If the piston is difficult to install by hand, remove the piston assembly and inspect the piston seals.

1033BE

Figure 118. Clutch Piston Installation

4. Lubricate and insert the steel thrust race [6] (thicker) onto the shaft. Ensure the steel thrust race is seated against the shaft shoulder. Lubricate and install the needle thrust bearing , followed by the outer steel thrust washer [7] (Thinner).

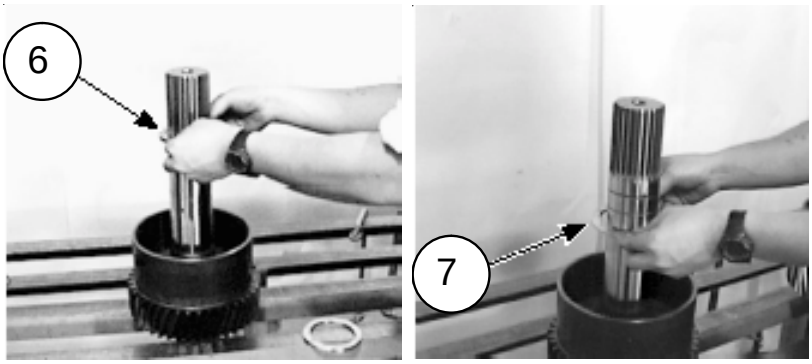

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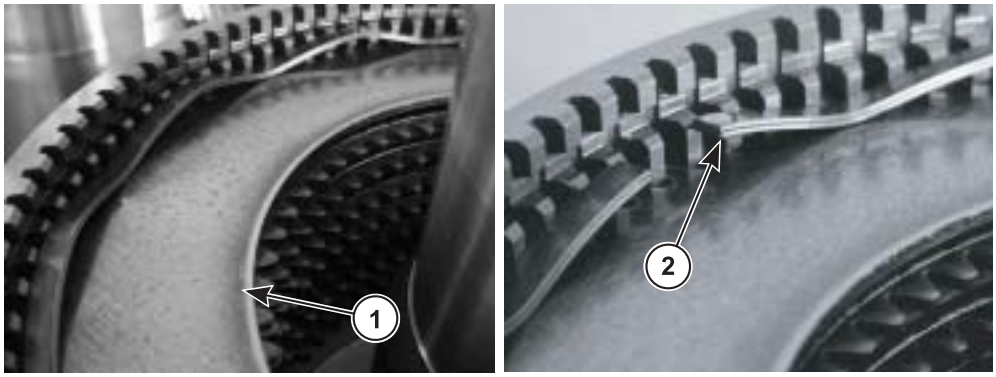
Figure 119. Installing Steel Thrust Race (6) and Bronze Thrust Washer (7)

5. Install the clutch plates.
   a. Install a steel [1] clutch plate next to the piston.
   b. Install a friction plate. Place two (a pair) wave springs [2] around the outer circumference of each friction plate. Each pair of wave springs is installed with the ends aligned. The wave spring pairs are installed with their ends oriented in a random manner.

Note: Some early units only have one wave spring per clutch plate.



RMVC026FGS RMVC028FGS

Figure 120. Clutch Plate (1) and Wave Spring (2) Installation

   c. Install the remaining clutch plates and wave springs in an alternating fashion until all clutch plates have been installed (12 steel plates, 11 friction plates, 11 pairs of wave springs).

Note: A steel plate is located next to the piston and the backing plate.

Installation Note:

Friction Plates: When installing clutch friction plates [3], install the plate with the rounded edge [5] away from the piston. The rounded edge makes installation of the pinion gear splines easier to align as the pinion gear is installed into the transfer gear.

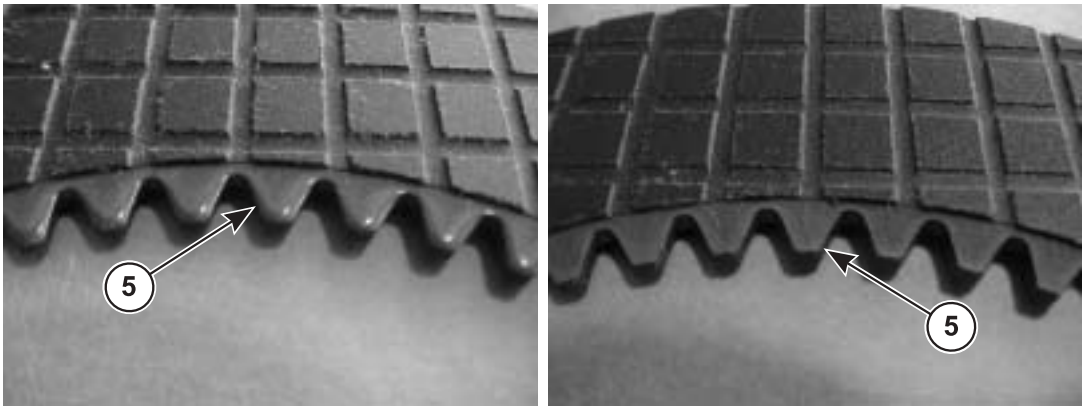


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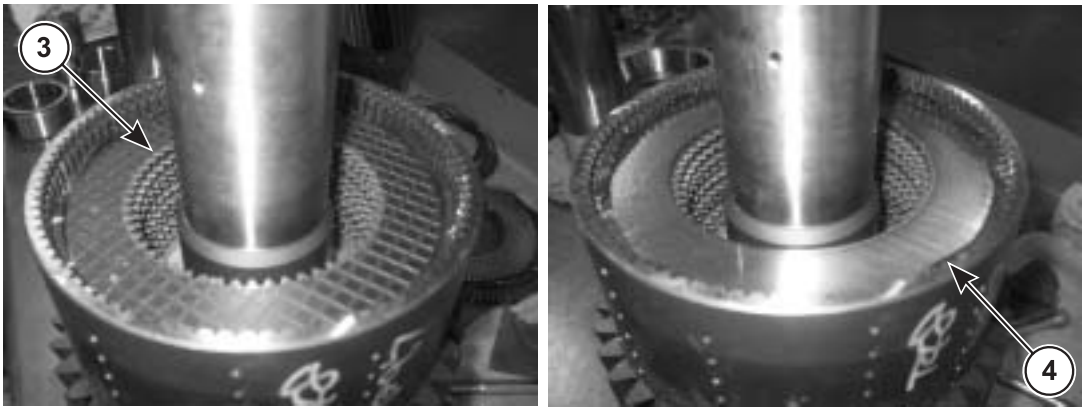
Figure 121. Clutch Friction Plate Edge (5), Rounded Edge and Sharp Edge Shown

Steel Plates: When installing steel clutch plates [4], install the plate with the rounded edge toward the piston. The rounded edge is easier to install into the transfer gear splines when installed in this manner.

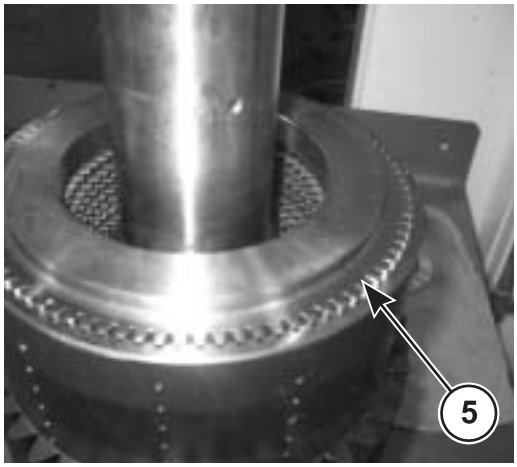


067 068

Figure 122. Clutch Friction Plate (3) and Steel Plate (4) Installation

6. Install the clutch backing plate [5]. Press the backing plate firmly into the clutch housing to ensure the splines of the clutch are aligned.

7. Place the internal snap (6) ring next to the clutch backing plate.



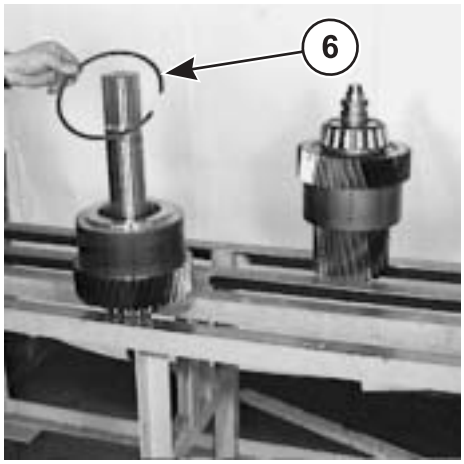


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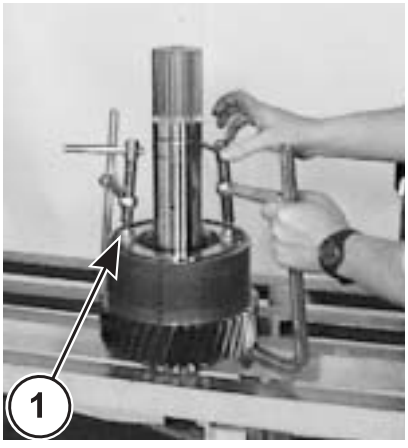
Figure 123. Clutch Backing Plate (5) and Internal Snap Ring (6)

8. Install two clamps [1] on the clutch housing and backing plate. Use the clamps to evenly compress the clutch until the internal snap ring can be installed properly into the clutch housing. Install the snap ring. Remove the clamps.

9. Lubricate the area of the clutch shaft [8] that will contact the pinion bushing. Install the pinion assembly [9]. Gently rotate the pinion as the pinion is lowered into the clutch plates until the splines are fully engaged in all of the clutch plates.



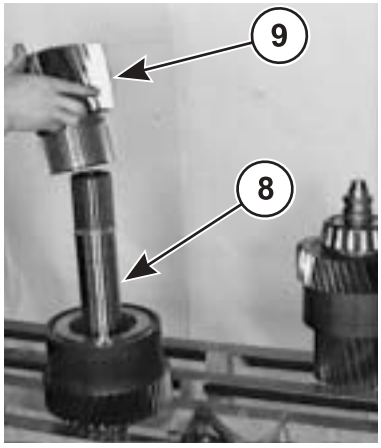


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Figure 124. Clutch Backing Plate (1) and Pinion Assembly (9)

10. Install the bronze [2] thrust washer (with 18 radial grooves) next to the pinion. Note that the bronze thrust washer for the primary shaft has a slightly smaller O.D. than the secondary shaft thrust washer.

    Note: If the pinion is fully engaged with all of the clutch plates, the round snap ring groove will be visible above the bronze thrust washer.

11. Install the round snap ring [3] onto the shaft to retain the bronze thrust washer.

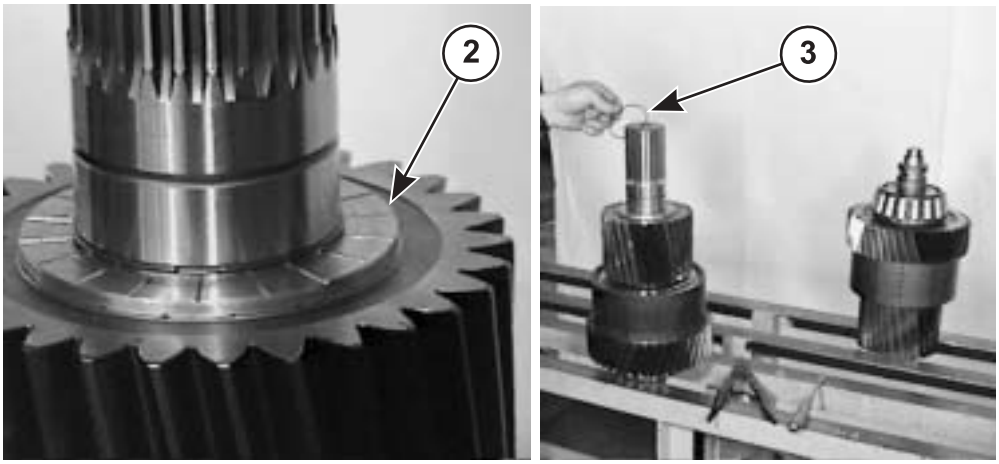

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Figure 125. Bronze Thrust Washer (2) and Round Snap Ring (3) Installation

12. Install the bearing carrier over the shaft with thrust flange towards the bronze thrust washer.

13. Verify the pinion has measurable end float. Invert the shaft assembly positioning the sealing ring end of the shaft down. Install the rear tapered roller bearing (if removed). Heat the clutch shaft rear bearing cone (4) to a temperature of 120°C (250°F). Place the bearing on the clutch shaft and push it firmly into position against the clutch housing.

    Note: Be sure to seat the bearing against the clutch housing as the bearing cools.

⚠ WARNING

Handle the bearing with care. The bearing is HOT.

RV SHAFT AND GEAR

Figure 126. RV Shaft and Gear

Secondary Clutch Shaft Assembly

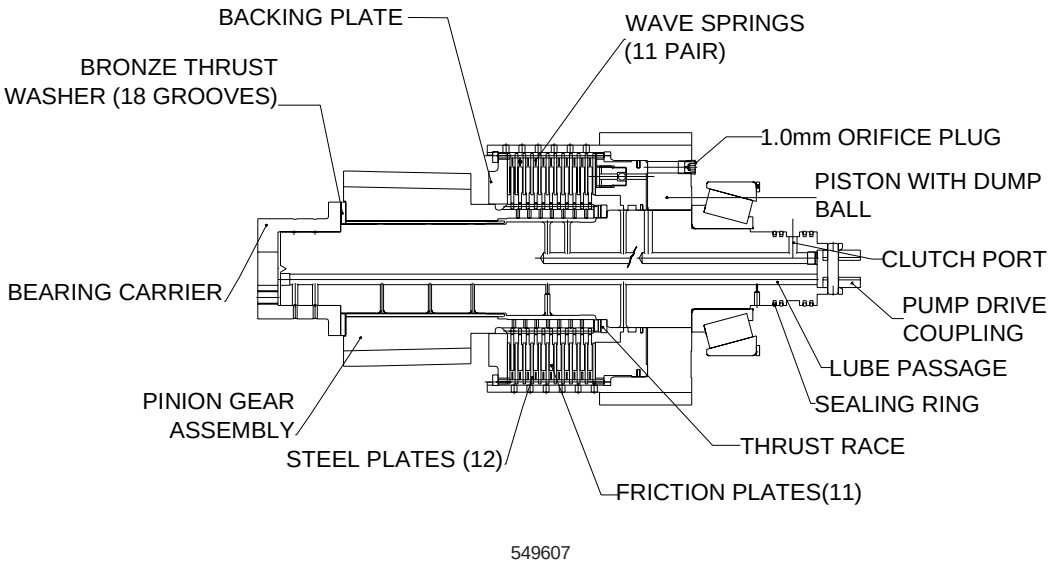

Figure 127. Secondary Clutch Shaft Component Identification and Location

1. Inspect the clutch piston dump valve [5] for proper operation. Be sure the dump valve ball is free to move. The clutch piston dump valve is not serviced separately.

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Figure 128. Clutch Piston with Dump Balls (5)

2. Install the pump drive coupling [6] into the rear end of the shaft if removed. Place the coupling in the end of the shaft and press the retaining pin through the components. When the retaining pin is flush [7] with the shaft, stake it in two locations at both ends of the pin.

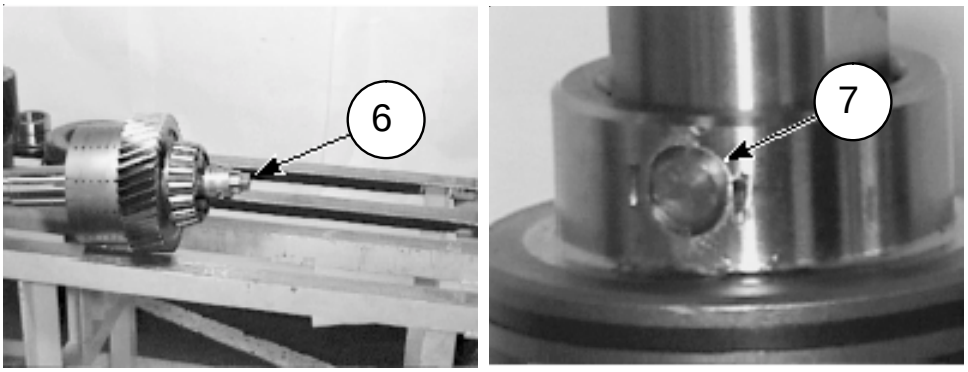

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Figure 129. Pump Drive Coupling (6 and 7) Installation

3. Replace the clutch piston seals [8]. Lubricate the clutch piston sealing rings before installing the piston into the clutch housing.

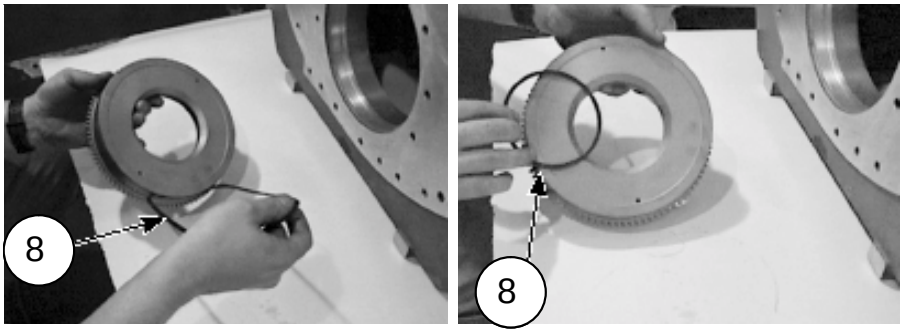

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Figure 130. Installing Cutch Piston Seals (8)

4. Lubricate the clutch piston bore with a thin film of grease. Install the piston into the clutch housing. Gently push the piston by hand until it is fully engaged into the clutch [9].

Note: If the piston is difficult to install by hand, remove the piston assembly and inspect the piston seals.

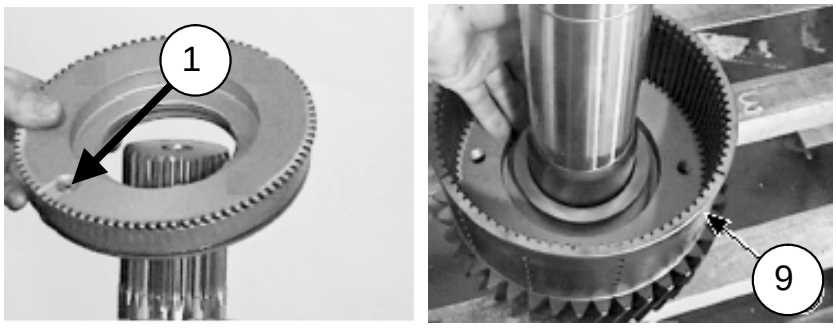

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Figure 131. Clutch Piston Installation

5. Lubricate and insert the steel thrust race [3] (thicker) onto the shaft. Ensure the steel thrust race is against the shaft shoulder. Lubricate and install the needle thrust bearing, followed by the [4] (thinner) steel thrust washer.

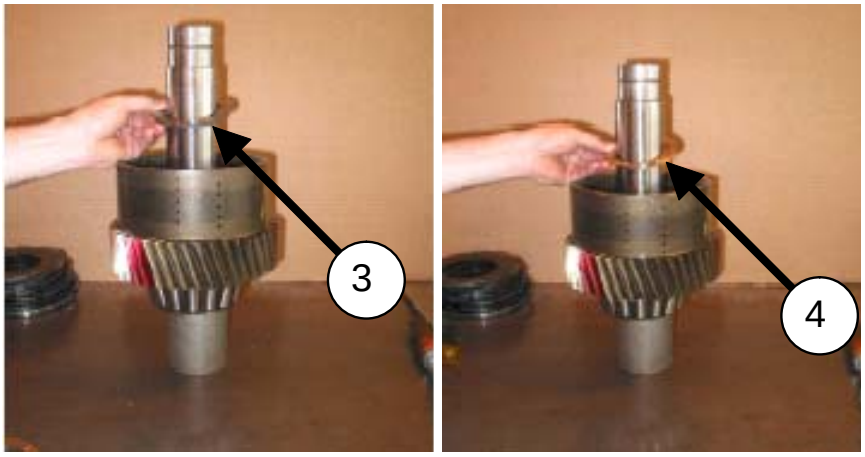

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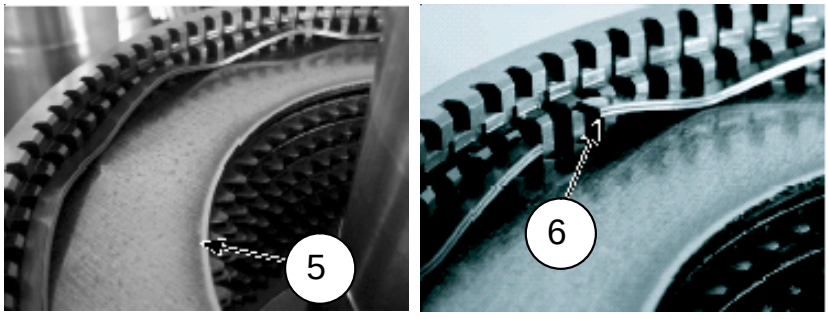
Figure 132. Installing Steel Thrust Race (3) and Bronze Thrust Washer (4)

6. Install the clutch plates.
   a. Install a steel [5] clutch plate next to the piston.
   b. Install a friction plate. Place two (a pair) wave springs [6] around the outer circumference of each friction plate. Each pair of wave springs is installed with the ends aligned. The wave spring pairs are installed with their ends oriented in a random manner.

   Note: Some early units only have one wave spring per clutch plate.



RMVC026FGS RMVC028FGS

Figure 133. Clutch Plate (5) and Wave Spring (6) Installation

c. Install the remaining clutch plates and wave springs in an alternating fashion until all clutch plates have been installed (12 steel plates, 11 friction plates, 11 pairs of wave springs).

Note: A steel plate is located next to the piston and the clutch backing plate.

Installation Note:

Friction Plates:

When installing clutch friction plates [8], install the plate with the rounded edge [7] away from the piston. The rounded edge makes installation of the pinion gear splines easier to align as the pinion gear is installed into the transfer gear.

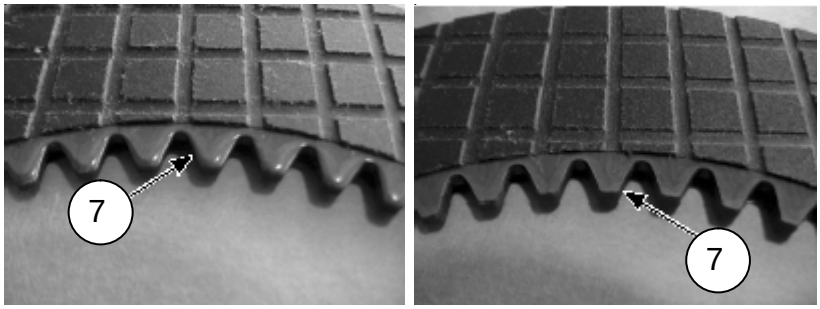


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Figure 134. Clutch Friction Plate Edge (7), Rounded Edge and Sharp Edge Shown

Steel Plates: When installing steel clutch plates [9], install the plate with the rounded edge toward the piston. The rounded edge is easier to install into the transfer gear splines when installed in this manner.

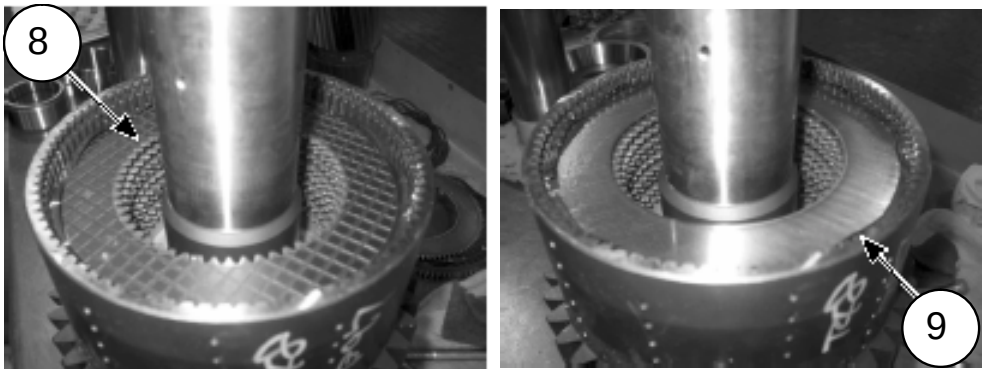

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Figure 135. Clutch Friction Plate (8) and Steel Plate (9) Installation

7. Install the clutch backing plate [1]. Press the backing plate firmly into the clutch housing to ensure the splines of the clutch are aligned.

8. Place the internal snap [2] ring next to the clutch backing plate.

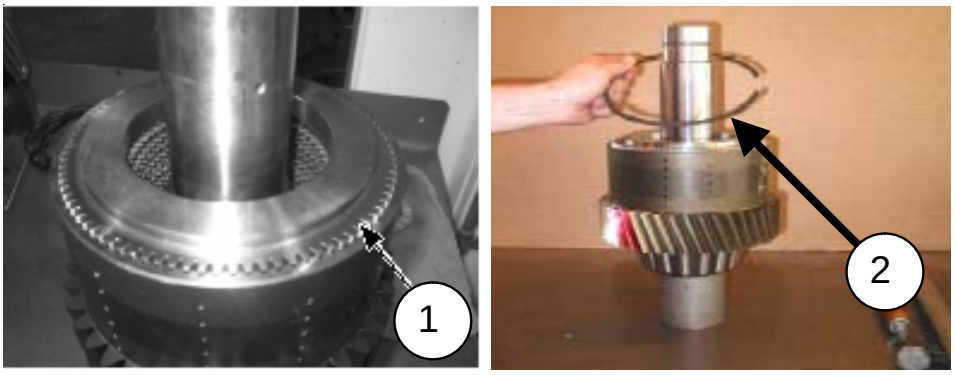

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Figure 136. Clutch Backing Plate (1) and Internal Snap Ring (2)

9. Install two clamps [3] on the clutch housing and backing plate. Use the clamps to evenly compress the clutch until the internal snap ring can be installed properly into the clutch housing. Install the snap ring. Remove the clamps.

10. Lubricate the area of the clutch shaft that will contact the pinion bushing. Install the pinion assembly [4]. Gently rotate the pinion as the pinion is lowered into the clutch plates until the splines are fully engaged in all of the clutch plates.

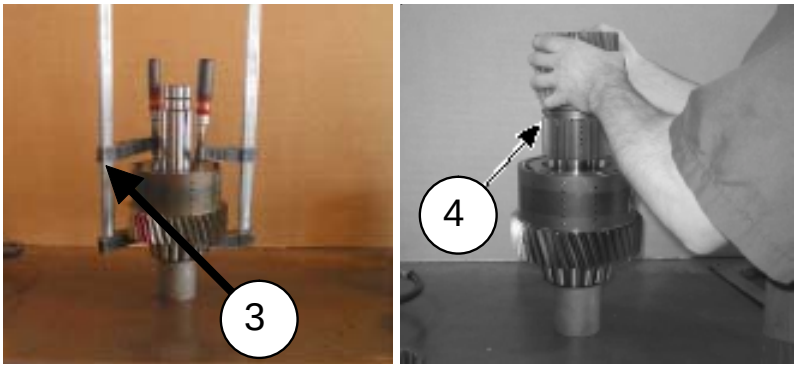

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Figure 137. Clutch Backing Plate and Pinion Assembly (4)

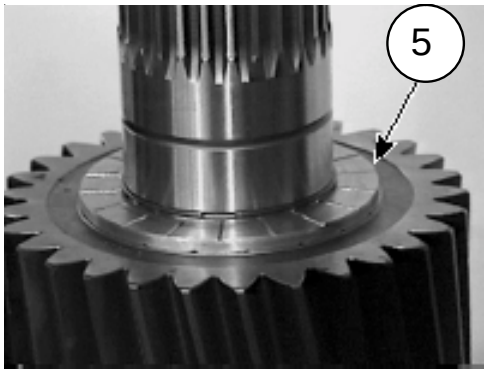
11. Install the bronze [5] thrust washer (with 18 radial grooves) next to the pinion. Note that the bronze thrust washer for the secondary shaft has a slightly larger O.D. than the primary shaft thrust washer.

12. Heat the secondary clutch shaft front bearing carrier [6] to a temperature of 120°C (250°F). Install the bearing carrier on the clutch shaft and push it firmly into position against the shaft shoulder as it cools.

⚠ WARNING

Handle the bearing carrier with care. The bearing carrier is HOT.

Note: The bearing carrier should contact the shaft (stop shoulder) as it is installed.



AAR200

Figure 138. Bronze Thrust Washer (5) Rear Bearing Carrier (6) Installation

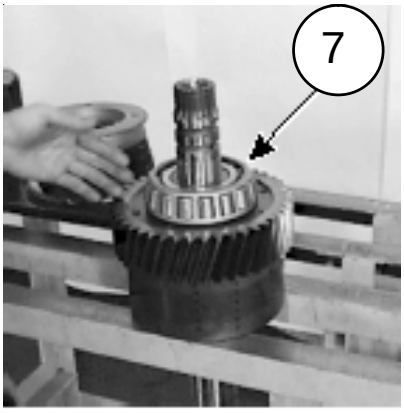
13. Verify the pinion has measurable end float.

14. Invert the shaft assembly positioning the sealing ring end of the shaft up. Install the rear tapered roller bearing (if removed). Heat the clutch shaft rear bearing cone [7] to a temperature of 120°C (250°F). Place the bearing on the clutch shaft and push it firmly into position against the clutch housing.

    Note: Be sure to seat the bearing against the clutch housing as the bearing cools.

⚠ WARNING

Handle the bearing with care. The bearing is HOT.



AAR193

Figure 139. Rear Bearing Cone (7) Installation

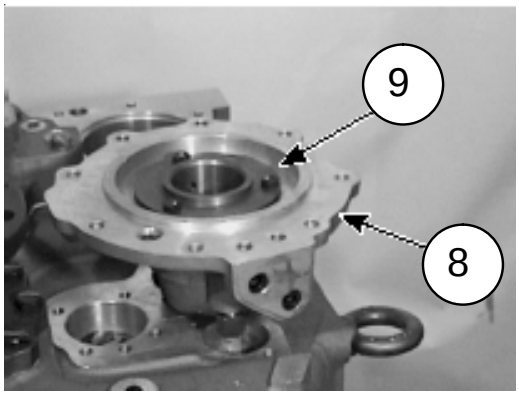
Primary and Secondary Shaft Seal Ring Insert Installation

1. Heat the aluminum cover [8] to 120°C (250°F). Cool the cast iron insert (9) to -20°C (-5°F).

⚠ WARNING

Handle the components (heated and cooled) with care. The cast iron insert will be located with three capscrews. Use three guide studs to index the insert in the cover correctly.

2. Install the new insert into the aluminum cover. Remove the guide studs, and install the two M8 screws and torque them to 23 N•m (17 lb•ft).



AAR283

Figure 140. Shaft Seal Ring Insert (9)

Trailing Pump Driven Gear Installation

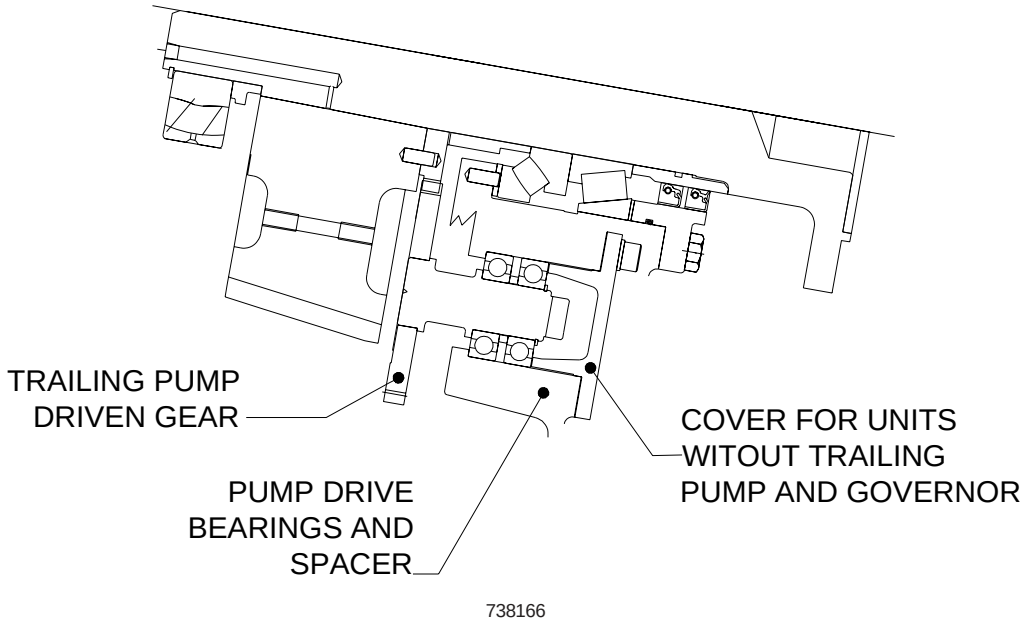


Figure 141. Trailing Pump Drive Component Identification and Location

Note: The housing should be placed with the front face down.

1. Lubricate the bore [1] of the transmission housing. Install the trailing pump drive shaft [2] through the bearing bore in the transmission housing.

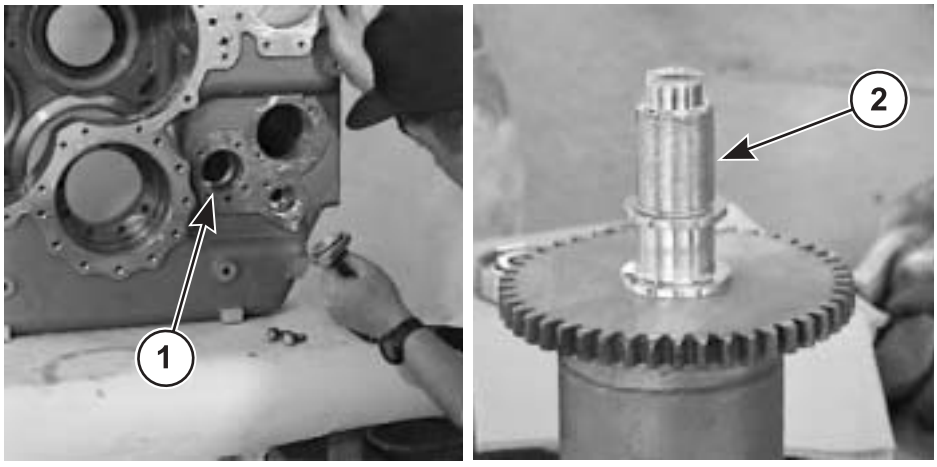


Figure 142. Trailing Pump Driven Shaft (2)

2. Position a spacer [3] below the shaft assembly (inside the transmission housing) to support the gear/shaft [4] in the correct position during the bearing installation process. Use tool T-111147 [5] to press the first bearing onto the trailing pump drive shaft.

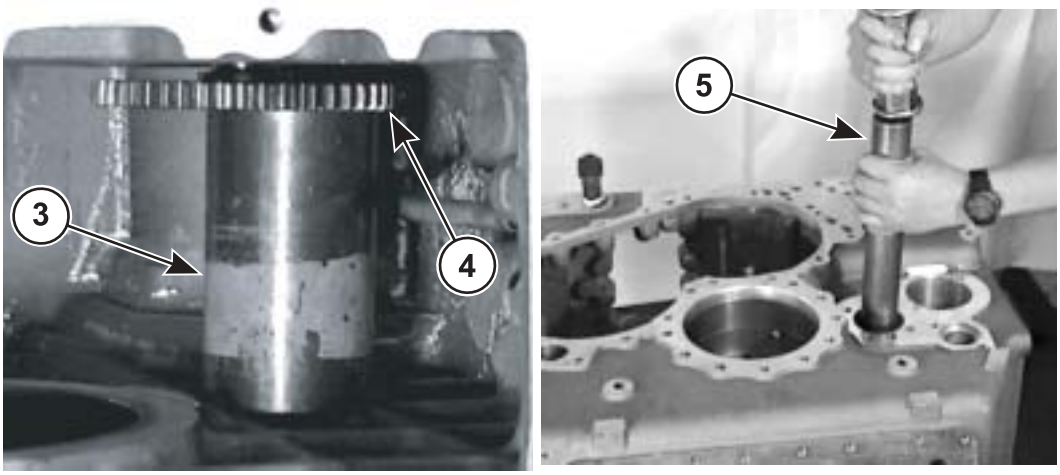


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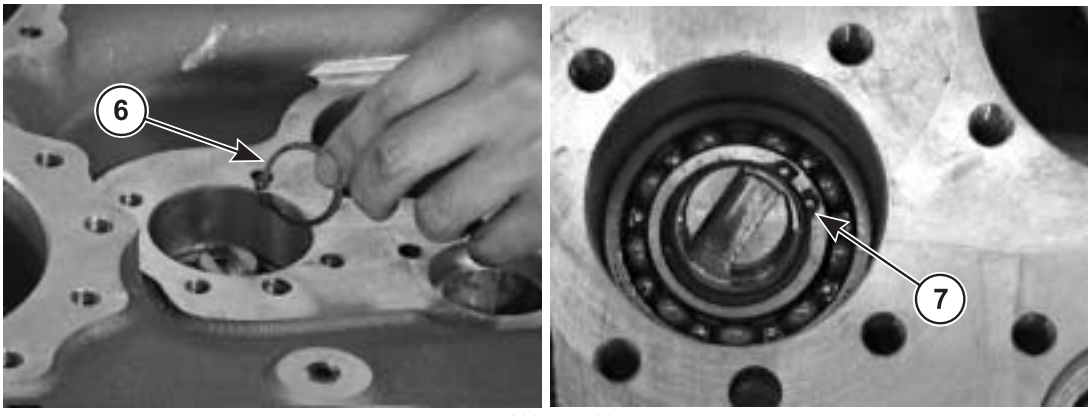
Figure 143. Trailing Pump Driven Gear/Shaft (4) and Bearing Installation

3. Install the spacer and the second bearing into the bearing bore. Press the spacer and bearing into position.

4. Install a snap ring [6] to retain the bearing on the pump drive idler shaft. If the snap ring [7] fits securely into position, the bearings and spacer are properly positioned.



AAR206 AAR204

Figure 144. Trailing Pump Driven Shaft Snap Ring (7) Installation

Output Shaft Installation

Output Shaft Bearing Adjustment

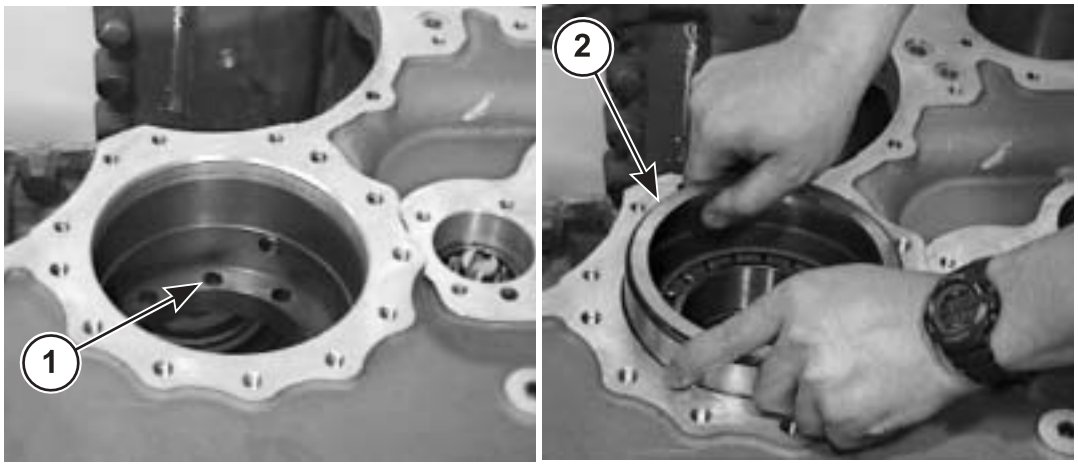
1. If not previously done, position the transmission housing with the output shaft end up.

   Note: Output shaft bearing adjustment is completed without springs installed in the pockets [1] of the transmission housing.

2. Apply a thin film of grease to the primary and secondary shaft front bearing bore inside the transmission housing. Press the primary and secondary shaft bearing cups into the transmission housing bore with an appropriate driver. The bearing cups should be a light slip fit.

3. Install the rear output shaft spherical roller bearing cup and cone into the transmission housing.

4. Install the rear output shaft tapered roller bearing cone next to the spherical roller bearing. Install the tapered roller bearing cup [2] into the transmission housing. Press the cup snugly against the rollers.



AAR221 AAR242

Figure 145. Output Shaft Bearing Spring Pockets (1) and Bearing (2)

5. Measure the depth of the tapered roller bearing cup into the transmission housing. Measure from the machined surface of the transmission housing to the rear surface of the tapered roller bearing cup [3].

   Measure in three, evenly spaced locations around the circumference of the bearing. If all three readings are identical, record the dimension. If the readings are not identical, adjust the bearings and measure again.

   Bearing Bore Depth = _____

6. Measure the length of the output seal carrier pilot. Record the dimension.

   Output Seal Cover Pilot Dimension = _____

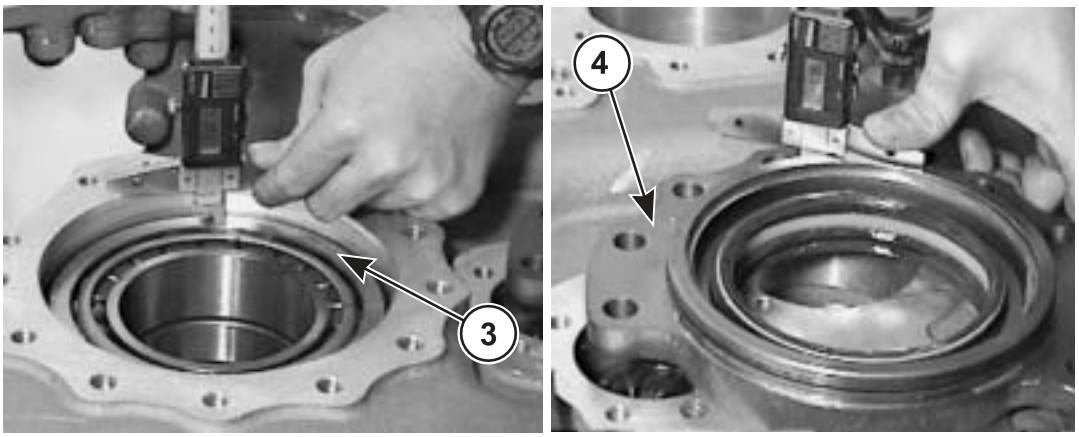


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Figure 146. Measuring Components to Determine Output Shaft Bearing Adjustment

7. Calculate the shim pack required to set the output shaft bearing clearance.
   a. Subtract the output seal carrier dimension from the bearing bore dimension. Bearing Bore Dimension - Seal Carrier Dimension = Output Bearing Clearance.
   b. Calculate the shim pack thickness required to obtain 0.00 - 0.05 mm (0.000 - 0.002 inches) bearing clearance when the shim pack is installed.
   c. Label the shim pack for use when assembling the output shaft subassembly.

8. Remove the output shaft rear bearings from the main transmission housing to allow for assembly of the output shaft.
   a. Place the housing with the input side on top.
   b. Use the output shaft spacer 177277 and tool T-21482-38 to press the bearings from the main housing.

Note: The tapered output bearing cup is a slight interference fit in the main housing. Removing the bearing assemblies will require some force.

Output Shaft Rear Bearing Removal

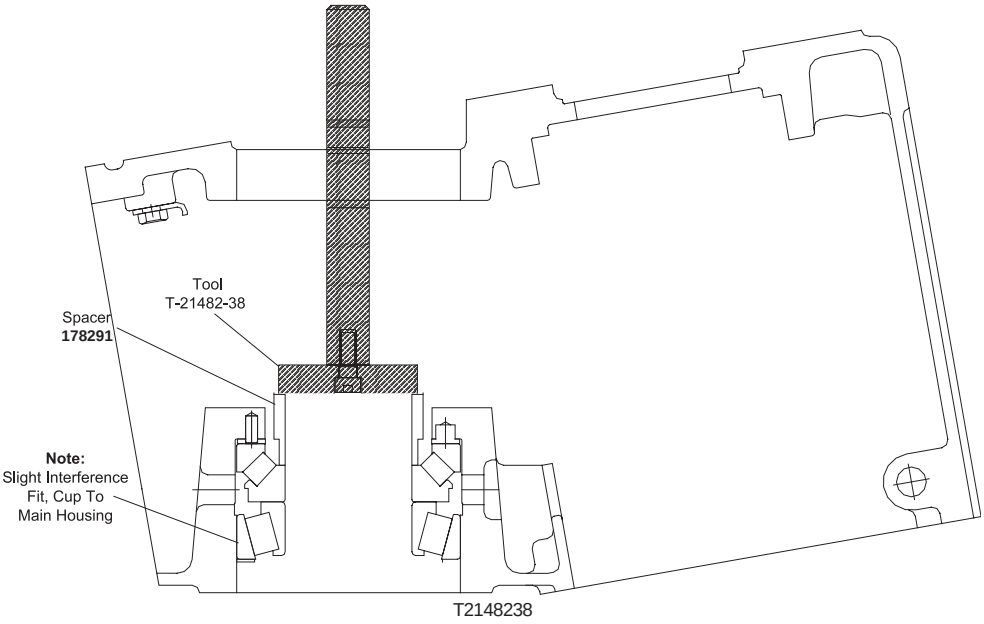

Figure 147. Removing Output Shaft Rear Bearings

Assembling the Output Shaft Subassembly

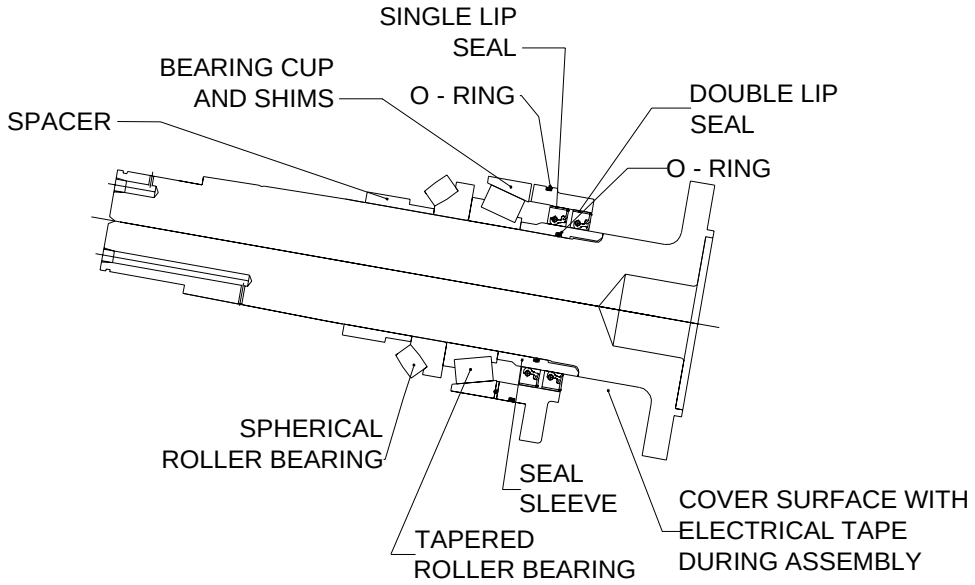

Figure 148. Output Shaft Component Identification and Location

1. Install the oil seal sleeve onto the output shaft.
   a. Install an O-ring into the groove in the inner bore of the oil seal sleeve. Lubricate the surface of the O-ring with grease. Apply a thin film of grease to the output shaft surface (from shaft midpoint to seal sleeve shoulder).

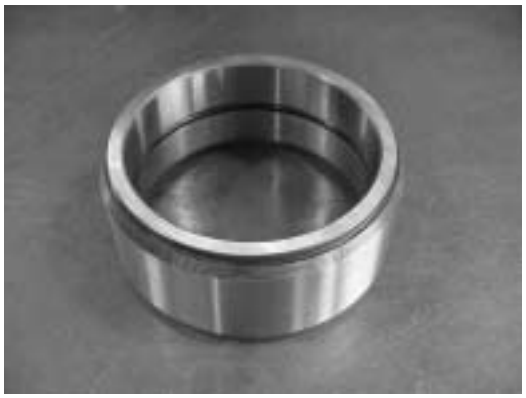

Figure 149. Oil Seal Sleeve O-ring Installation

b. Place the oil seal sleeve [1] onto the output shaft with the counterbored end toward the output flange.

Note: The oil seal sleeve must contact the output shaft shoulder.

c. Lubricate the surface of the shaft between the output flange and the oil seal sleeve.

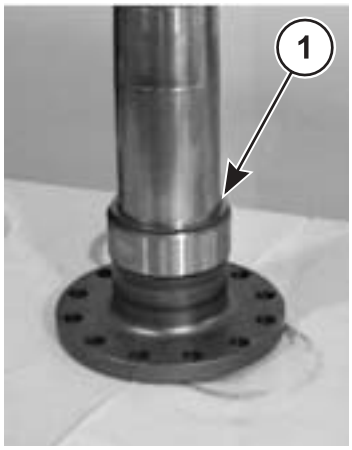

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Figure 150. Oil Sleeve Installation on Output Shaft

3. Install new output shaft seals into the seal carrier using a seal driver.

   a. Apply MA1015 or equivalent sealer to the outside diameter of the oil seals and the bore of the oil seal carrier.
   b. Drive the inner seal (single lip seal) until it is flush with the inside surface of the oil seal carrier. Install seal with the spring-loaded lip toward the inside of the seal carrier.
   c. Drive the outer seal (double lip seal) until it is flush with the outside surface of the oil seal carrier. Install seal with the spring-loaded lip toward the inside of the seal carrier.
   d. Apply grease to the oil seal lips and to the oil seal sleeve surface on the output shaft.

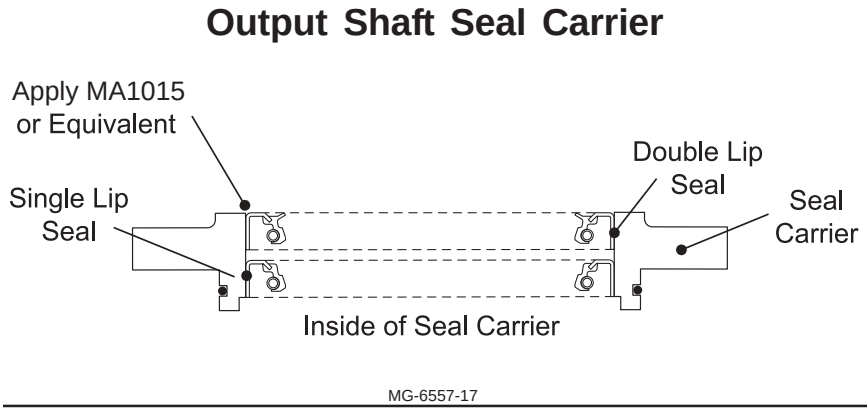

Figure 151. Output Shaft Seal Carrier Assembly

4. Install oil seal carrier [3] onto the output shaft.

5. Install the correct (previously selected) shim pack [4] onto the output shaft.

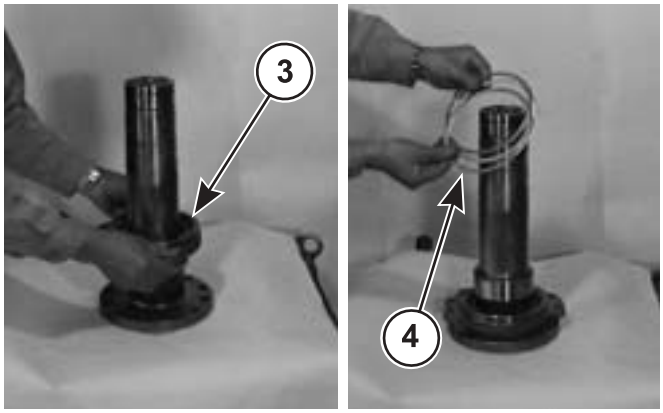

Figure 152. Oil Seal Carrier (3) and Shim Pack (4) Installation

6. Install the output shaft tapered roller bearing cup [5].

⚠ WARNING

The following steps of this procedure require components to be heated prior to installation. Use caution when handling the heated components.

7. Install the output shaft tapered roller bearing cone [6].
   a. Heat the output shaft tapered roller bearing cone to 120°C (250°F).
   b. Place the tapered roller bearing cone onto the output shaft with the small diameter end of the bearing toward the bearing cup. Slide the bearing onto the shaft until it contacts the shoulder of the output shaft seal sleeve.

8. Install the output shaft spherical roller bearing cone [7].
   a. Heat the output shaft spherical roller bearing cone to 120°C (250°F).
   b. Place the spherical roller bearing cone onto the output shaft with the large diameter of the bearing toward the bearing installed previously. Slide the bearing onto the shaft until it contacts the rear tapered roller bearing cone.

9. Install the bearing spacer [8].
   a. Heat the bearing spacer to 120°C (250°F).
   b. Place the bearing spacer onto the output shaft with the small diameter end towards the spherical bearing cone. Slide the bearing spacer onto the shaft until it contacts the spherical roller bearing race.

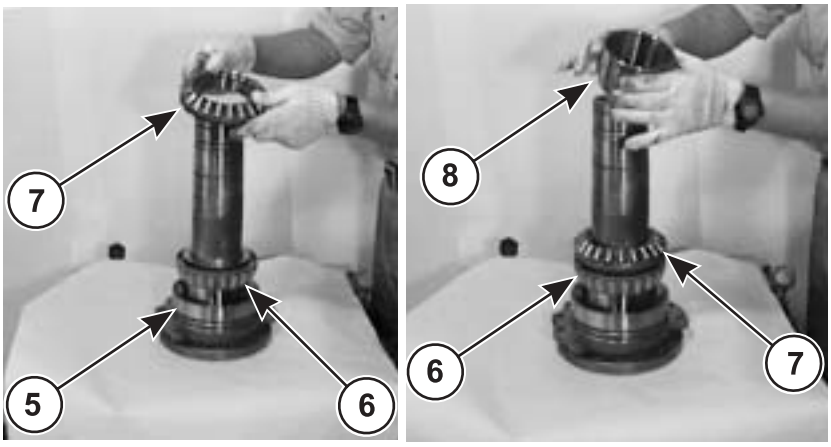

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Figure 153. Tapered Bearing Cup (5), Tapered Bearing Cone (6), Spherical Roller Bearing Cone (7), and Bearing Spacer (8) Installation

10. Ensure the components are properly seated on the shaft. Use a pressing sleeve and press to ensure the components are properly placed on the shaft.

11. Install threaded rods and spacers [9] to the output flange and seal carrier. The tool is used to maintain the position of the output shaft seal carrier during installation in the transmission housing. Maintaining the seal carrier position protects the seal during assembly into the transmission housing.

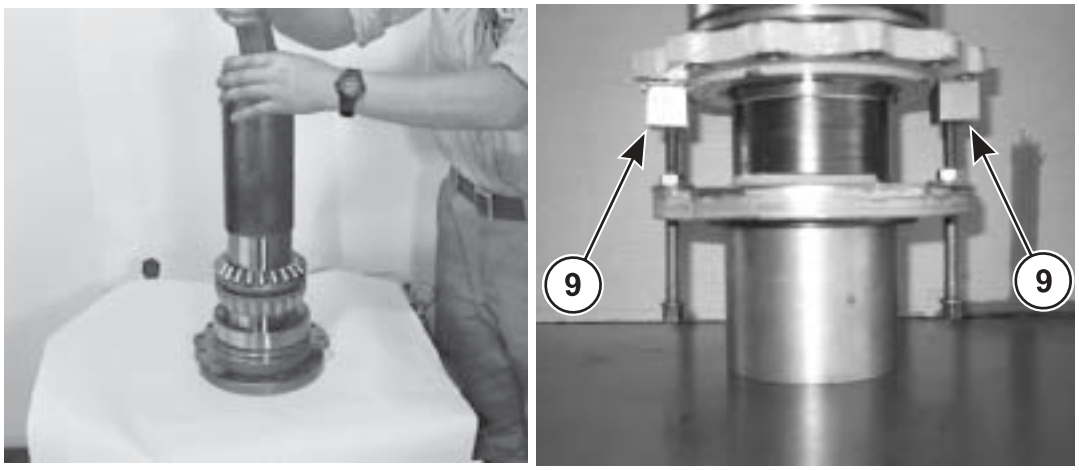

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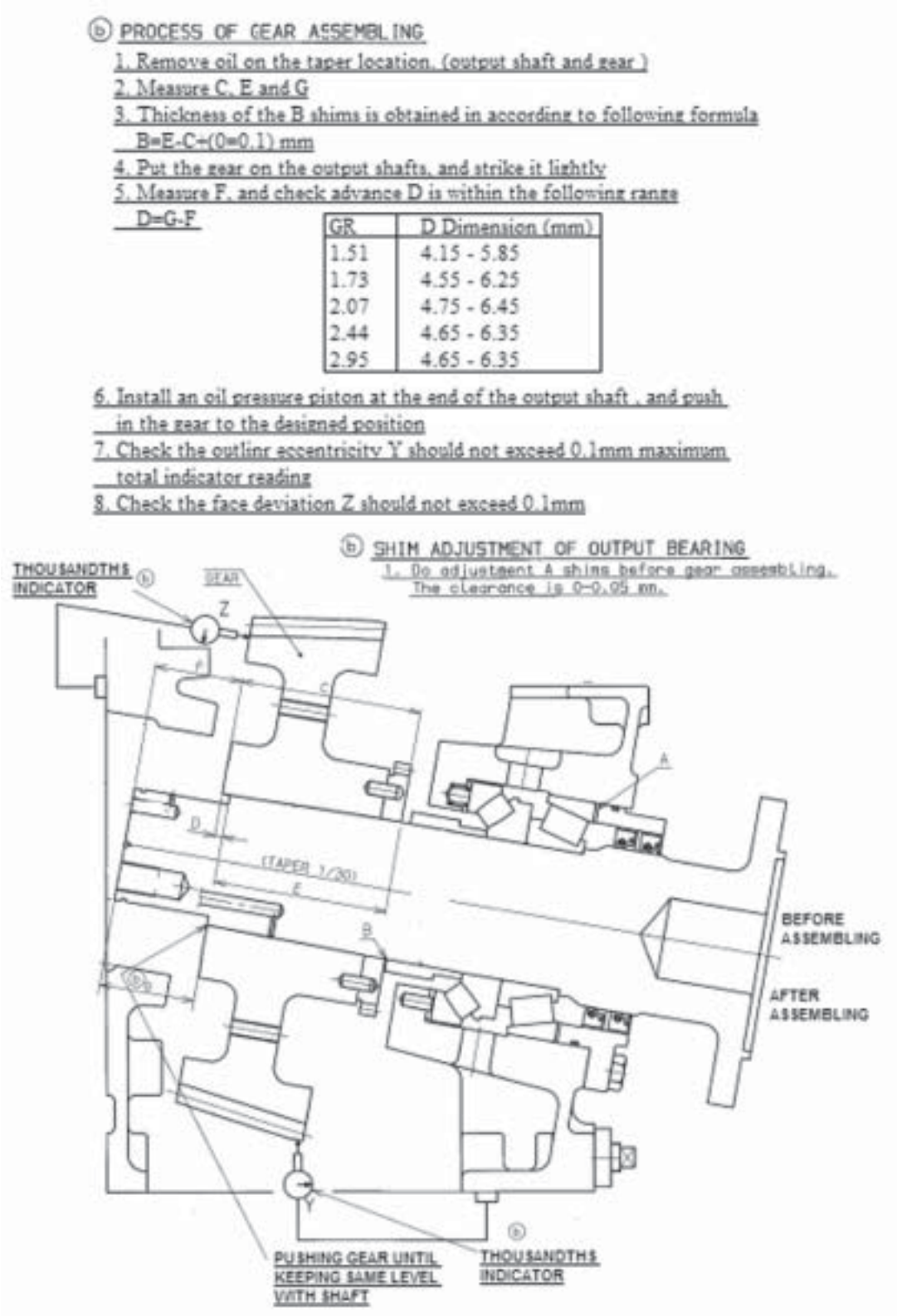
Figure 154. Pressing Output Shaft Component with sleeve and Installing spacers (9) on Seal Carrier

Preliminary Output Shaft/Gear Advancement Verification


ⓑ PROCESS OF GEAR ASSEMBLING
1. Remove oil on the taper location. (output shaft and gear)
2. Measure C, E and G
3. Thickness of the B shims is obtained in according to following formula
B=E-C+(0~0.1) mm
4. Put the gear on the output shafts, and strike it lightly
5. Measure F, and check advance D is within the following range
D=G-F
GR | D Dimension (mm)
1.51 | 4.15 - 5.85
1.73 | 4.55 - 6.25
2.07 | 4.75 - 6.45
2.44 | 4.65 - 6.35
2.95 | 4.65 - 6.35
6. Install an oil pressure piston at the end of the output shaft , and push in the gear to the designed position
7. Check the outline eccentricity Y should not exceed 0.1mm maximum total indicator reading
8. Check the face deviation Z should not exceed 0.1mm
ⓑ SHIM ADJUSTMENT OF OUTPUT BEARING
1. Do adjustment A shims before gear assembling. The clearance is 0~0.05 mm.
THOUSANDTHS INDICATOR
GEAR
Z
C
A
D
(TAPER 1/20)
E
B
BEFORE ASSEMBLING
AFTER ASSEMBLING
Y
PUSHING GEAR UNTIL KEEPING SAME LEVEL WITH SHAFT
THOUSANDTHS INDICATOR

Input Advance

Figure 155. Output Shaft Advancement Procedure

1. Clean and inspect the output gear tapered bore.
   a. Prepare the gear tapered bore surface for assembly by using a Scotchbrite® pad to remove any burrs.
   b. Clean the shaft tapered surface and the gear bore with an appropriate solvent. Dry the shaft and clear all oil passages in the shaft with compressed air.

⚠ CAUTION

If the gear or shaft is damaged and cannot be repaired without material removal, replace the part.

⚠ CAUTION

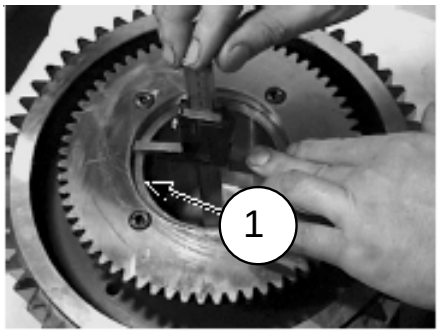
The tapered surface of the shaft and matching tapered gear bore must be completely free of grease, oil dirt, and solvent residue. Failure to properly clean mating parts could prevent proper advance of the gear on the shaft and adversely effect torque carrying capacity of the assembled joint.

2. Install the trailing pump drive gear if it was removed from the output gear.

3. Measure the output gear bore depth dimension (including pump drive gear).

   Place the output gear on a flat uniform surface such as a layout table. Measure from the edge (1) of the output gear to the surface of the layout table. Include the thickness of the trailing pump drive gear.
   Measure in three locations around the circumference of the output gear bore. The three readings should be identical. Record this distance as dimension C (reference drawing).

   Gear Thickness Dimension C = _____



AAR234

Figure 156. Output Gear Thickness Measurement (1)

4. Measure the output shaft shoulder to spacer dimension as follows.
   Measure from the shaft shoulder to the front edge of the spacer located next to the spherical roller bearing.
   Measure in three locations around the circumference of the shaft. The three readings should be identical.
   Record this distance as dimension E (reference drawing).

   Dimension E = _____

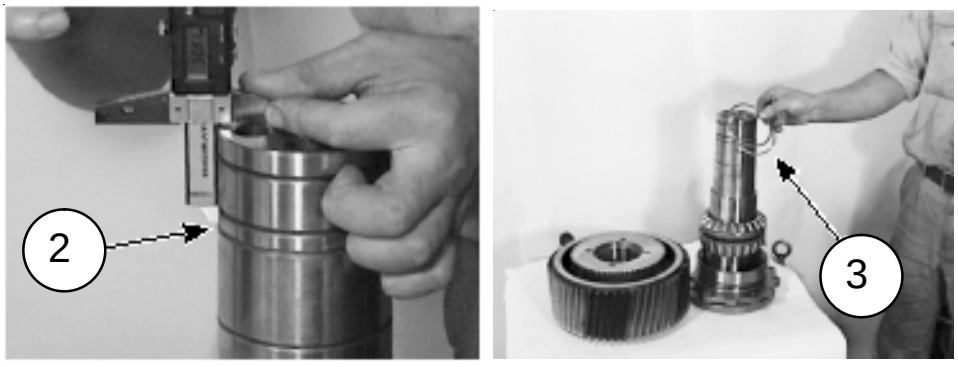
5. Measure the output shaft end to shoulder dimension as follows.
   Measure from the front end of the output shaft to the front edge of the shoulder [2] on the shaft.
   Measure in three locations around the circumference of the shaft. The three readings should be identical. Record this distance as dimension G (reference drawing).

   Dimension G =_____

6. Calculate the correct shim pack (reference drawing dimension B) required to set the output gear advance on the output shaft as follows.
   Calculate the shims.
   Dimension (E) - (Dimension C) + (0.00 - 0.1 mm) = Shims (Dimension B).
   Dimension (E) - (Dimension C) + (0.00 - 0.004 in.) = Shims (Dimension B).

7. The calculated shim pack [3] will be installed on the output shaft between the spacer and the output gear.

   DO NOT install the shim pack at this time. The shim pack will be installed as the output shaft is lowered into the transmission housing.



AAR232 AAR233

Figure 157. Shaft End to Shoulder (2) Measurement and Shim Pack Installation

88. Measure the expected gear advance to ensure it falls into the range as listed in the table below.

Table 9. Gear Advance Table

GR	Dimension (mm)
1.51	4.15 – 5.85
1.73	4.55 –6.25
2.07	4.75 – 6.45
2.44	4.65 – 6.35
2.95	4.65 – 6.35

a. Place the gear on the output shaft. Seat the gear on the shaft by tapping it with a dead-blow hammer to measure expected gear advance.

b. Measure from the front end of the output shaft to the front edge of the output gear. Record this distance as dimension F (reference drawing).

Dimension F = _____

c. Calculate the expected gear advance, dimension D (reference drawing).
Dimension D = Dimension G - Dimension F
Dimension D should fall into the range of as shown in the table above.

⚠ CAUTION

If the calculated advance falls outside the range given above, check to ensure all measurements/calculations are correct. If no errors are found it will be necessary to change parts. Contact the Product Service Department of Twin Disc, Incorporated.

9. Ensure the output gear bore is clean and free of grease and other contaminants. Install two M10-1.5 eyebolts into the output gear [4] and place it in the transmission housing with the trailing pump drive gear [5] towards the rear side of the transmission housing. Align the output gear with the output shaft bore in the transmission housing.

⚠ CAUTION

The tapered surface of the shaft and matching tapered gear bore must be completely free of grease, oil dirt, and solvent residue. Failure to properly clean mating parts could prevent proper advance of the gear on the shaft and adversely effect torque carrying capacity of the assembled joint.

10. Place the shim pack [6] on top of the output gear bore [7]. Ensure the shims are centered on the bore of the output gear.

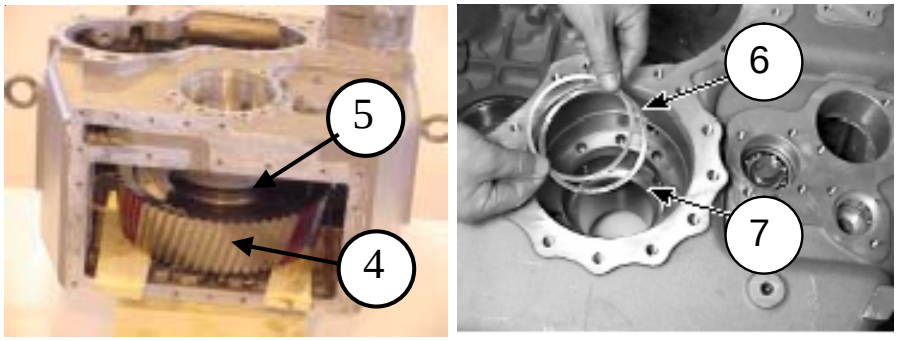


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Figure 158. Output Gear (4) Placement in Transmission and Shim Installation

11. Fill the nine spring pockets in the bearing bore of the transmission housing with grease.

Note: The grease will be used to retain the springs in the spring pockets while the transmission housing is rotated.

12. Install a spring in each of the spring pockets of the transmission housing. Ensure each spring is firmly held in its bore within the housing.

13. Install the spherical bearing cup into the transmission housing next to the springs. The spherical bearing cup is a slip fit in the transmission housing.

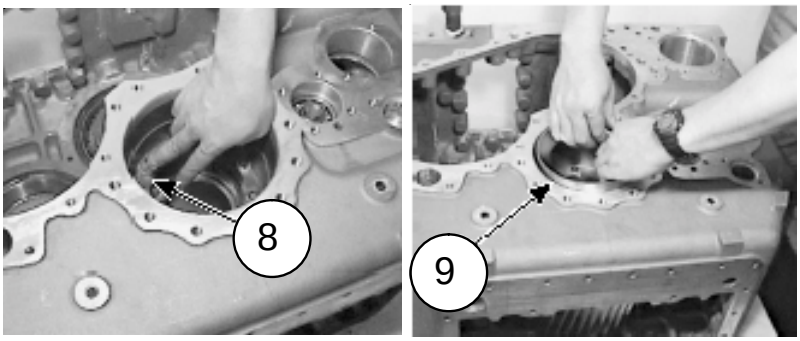

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Figure 159. Output Shaft Bearing Spring (8) and Bearing Cup (9) Installation

14. Ensure the surface of the shaft taper is clean and free of grease and other contaminants. Lightly grease the output bore [1] of the transmission housing and the O-ring [2] of the seal retainer on the output shaft subassembly. Slowly lower the shaft subassembly into the transmission housing, through the shims and the output gear assembly.

⚠ CAUTION

Carefully lower the shaft into the transmission housing as the seal carrier is installed into the housing. Damage to the shaft seals could result if appropriate care is not taken during the installation process.

15. Gently tap the end of the output shaft with a dead-blow hammer, if necessary, to guide the seal retainer into the housing.

Note: There will be a slight interference fit between the main housing and the seal retainer.

Note: When the shaft is installed, a small gap [3] will be present between the transmission housing and the seal retainer. This gap is a result of the springs installed between the transmission housing and the spherical bearing cup.

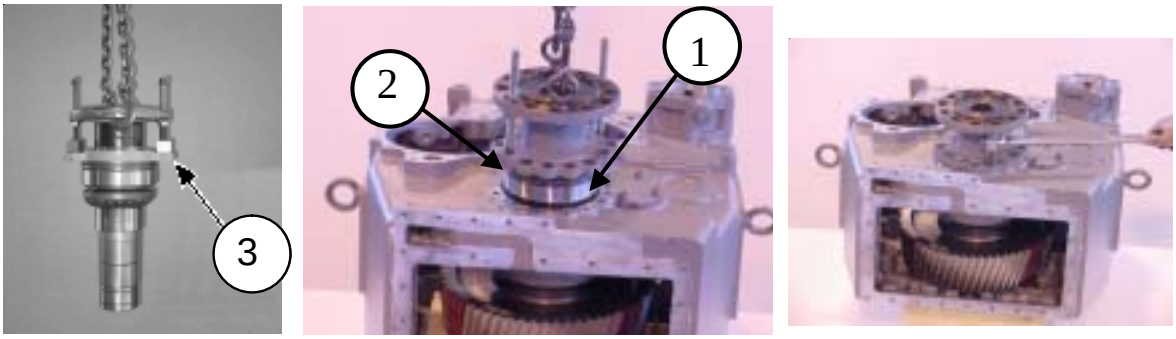


Figure 160. Output Shaft Assembly Placement in Transmission Housing

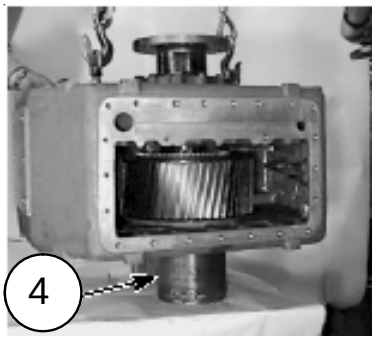
16. Install the seal retainer screws and tighten them evenly. Torque the nine screws to 80 N•m (59 lb•ft).

17. Raise the transmission housing. Support the output gear with a cylindrical support that will stop on the shoulder of the shaft [4]. Lower the transmission housing until the output gear (only the gear not the housing) is supported firmly by the tool.

18. Seat the shaft taper in the bore of the output gear. Use a mallet to tap firmly on the end of the output shaft flange [5], seating the tapered joint.

⚠ CAUTION

Monitor the position of the trailing pump drive and driven gear during output shaft installation to prevent interference of the gear teeth.



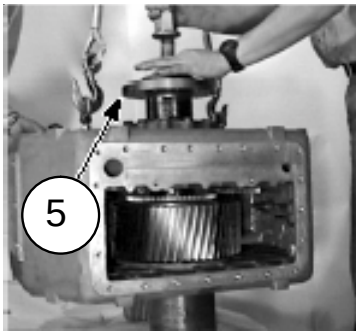


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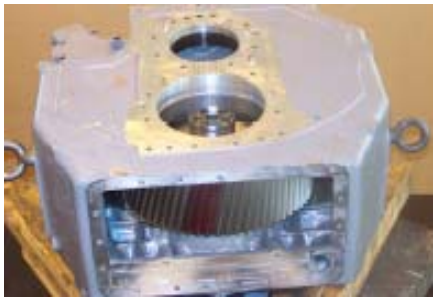
Figure 161. Seating Output Gear on Output Shaft

19. Rotate the transmission with the input end up. Install tool AM814A [6] onto the output shaft assembly [7].



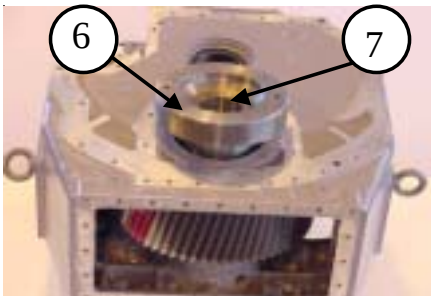


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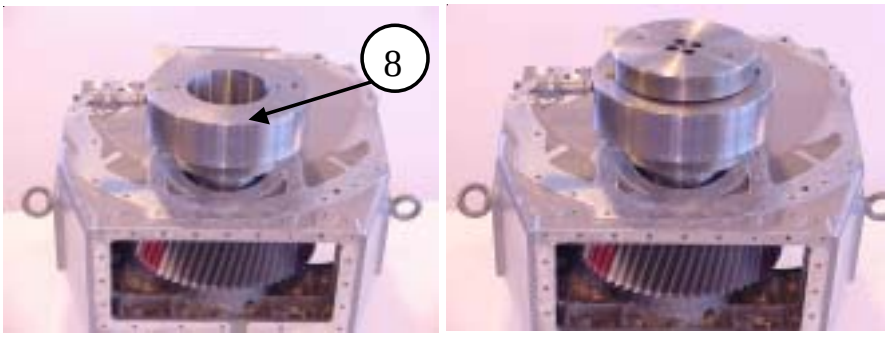
Figure 162. Tool T-21482 (5) Placement

20. Install tool T-21482-2 (8) over tool AM814A.

21. Install tool AM814 on top of tool T-21482-2.



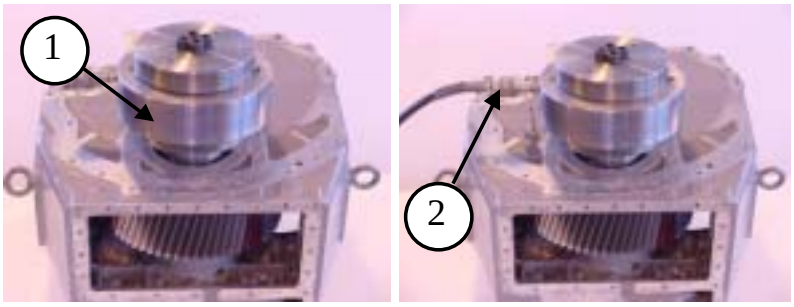
MVC896E MVC897E

Figure 163. Installing Tool T-21482-2 (8)

22. Connect tool AM814 to the output shaft using four M18 x 1.5 socket head capscrews. Tighten the capscrews to a torque of 440 N•m (325 lb•ft).

23. Connect a hydraulic power [2] supply to tool T-21482-2.

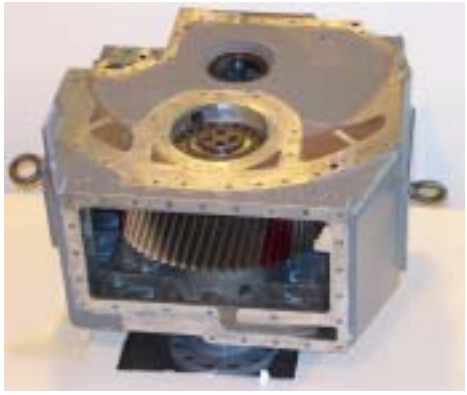
24. Seat the output gear on the output shaft taper with 50,000 kPa (7,250 psi). Hold the pressure on the assembly for a minimum of five minutes.



MVC898E MVC899E

Figure 164. Using Tool AM814 and T21482-2 [1] to seat the Output Gear on the Output Shaft

25. Remove the tools.



DCP 0998

Figure 165. Removal Tools

26. Verify the output gear advancement on the output shaft.

    a. Measure the distance from the shaft shoulder (near the output gear) to the end of the shaft. Record this dimension as dimension D.

       Dimension D =_____

    b. Measure the distance from the edge of the output gear to the end of the output shaft. Record this dimension as dimension E.

       Dimension E =_____

    c. The differences between these two dimensions (E - D) should be 0.00 - 0.05 mm (0.00 - 0.002 inches).

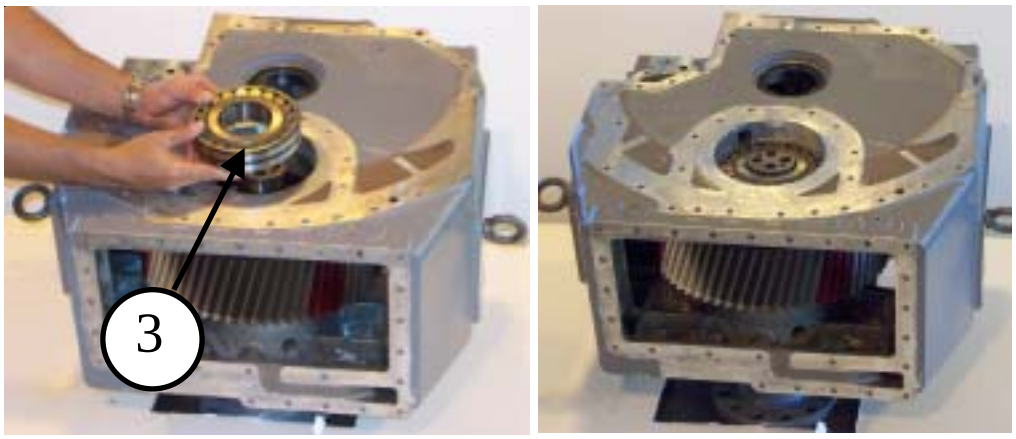
    d. If the output gear requires further advancement, reinstall the tools and reapply pressure to advance the output gear.
       If the gear cannot be advanced the proper distance, the shim pack thickness should be checked. Checking the shim pack dimension will require disassembly.

    e. If the shim pack thickness is correct and the output gear cannot be advanced the proper distance, consult the Product Service Engineering Department at Twin Disc.

27. Install the spacer over the shaft with the smaller diameter end toward the gear.

28. Install the spherical roller bearing on the end of the output shaft. Carefully align the components to ease installation. Gently tap the inner bearing race if necessary, to align the assembly during installation. Make sure the snap ring is installed, retaining the bearing to the shaft.

Note: If the spherical bearing becomes out of alignment, the assembly will become impossible.



DCP 0991 DCP 0992

Figure 166. Spherical Bearing (3) Installation in Transmission Housing

DCP 0995

Figure 167. Snap Ring Installation

Gear Pan and Bottom Cover Installation

1. Install the gear pan [5] into the main transmission housing around the lower portion of the output gear (2 of M10-1.5 x 25mm). Torque the bolts to 46 N•m (34 lb•ft).

2. Place MA1015 sealer on the sealing surface of the bottom cover [6]. Place enough sealant on the housing to adequately seal the transmission bottom cover. (17 of M10-1.5 x 30mm, 5 of M10-1.5 x 50mm, 4 of M101.5 x 60mm)

   Note: Apply nickel anti-seize compound to threads before torquing the screws (stainless steel) to 34 N•m (25 lb•ft).

⚠ IMPORTANT

Be sure to seal the surfaces around the two screws that pass through the center of the bottom cover. Leaks will result if the bottom cover is not properly sealed.

DCP 0162 DCP 0160

Figure 168. Gear Pan (5) and Bottom Cover (6) Installation

3. Rotate the transmission and place it with the output side at the top. Be sure transmission is supported securely.

Installing Primary and Secondary Shafts

1. Install lifting eyes (M10-1.5) into the primary shaft clutch housing. Install the front bearing for the primary and secondary shaft.

DCP 0157 DCP 0156

Figure 169. Installing front bearing for the Primary and Secondary Clutch Shaft into Transmission Housing.

2. Install the primary shaft assembly into the transmission housing with a hoist.

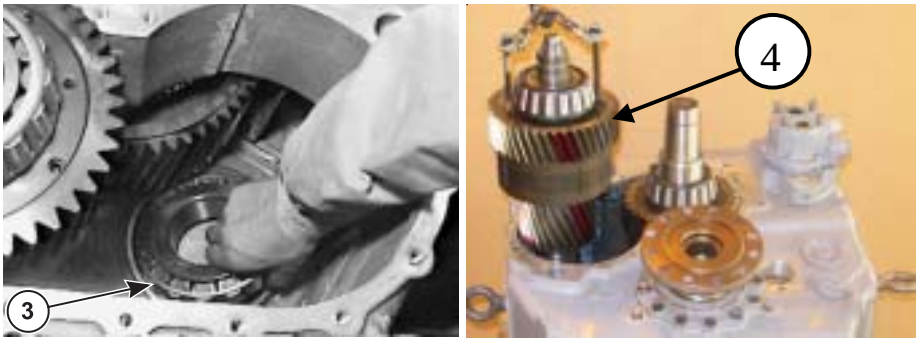
DCP 5704

Figure 170. Lowering Primary Clutch Shaft into Transmission Housing

3. Install the front bearing cone [3] for the secondary shaft if not already done. Apply a thin film of grease to the inner bore of the bearing cone.

4. Apply a thin film of grease to the front bearing carrier on the secondary shaft. Install the secondary shaft assembly [4] into the transmission housing. The bearing carrier of the secondary shaft is a slip fit into the bore of the front bearing cone.

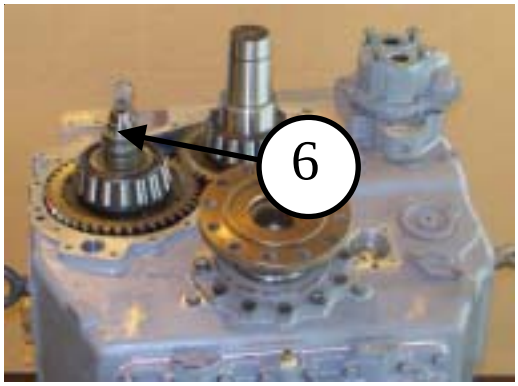
Note: Assembly will be difficult if the clutch shaft assembly is not perfectly aligned.



AAR263 DCP 5707

Figure 171. Secondary Clutch Shaft Bearing Cone (3) and Lowering Secondary Clutch Shaft into Transmission Housing

5. Install the sealing rings on the secondary [6] shaft. Apply a light coat of grease to all of the sealing rings. Install the O-ring located in the transmission housing behind the manifold.



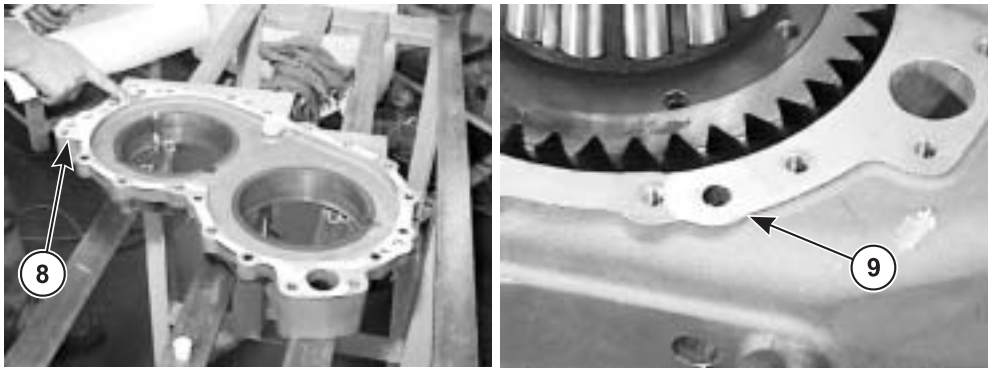
DCP 5708

Figure 172. Clutch Shaft Sealing Ring Installation

Install Manifold

1. Place a thin film of MA1015 sealant on the sealing surface [8] of both the manifold and housing.

2. Place MA1015 sealant around the dowel pin holes [9] in the main transmission housing.

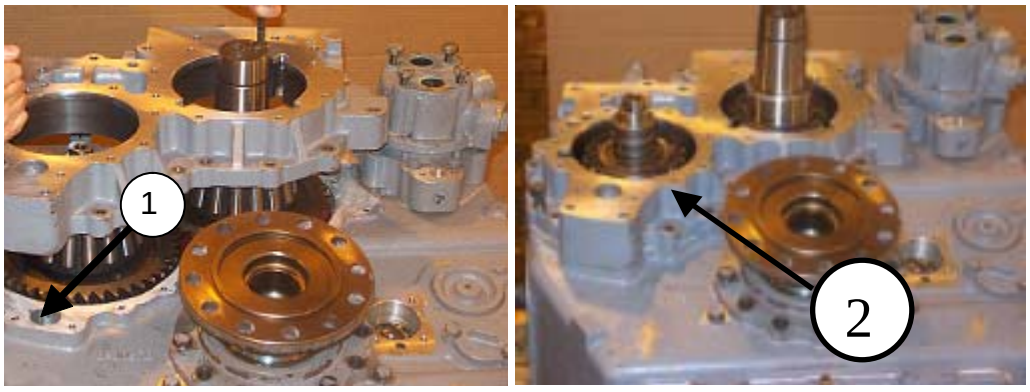


AAR265 AAR265

Figure 173. Seal Manifold Surface (8) and Dowel Pin (9) Locations

3. Install the O-ring [1] located in the transmission housing behind the manifold.

4. Install the manifold [2] onto the main transmission housing.



DCP 5743 DCP 5744 .

Figure 174. Install O-rings (1) in Transmission Counter Bores

5. Install the manifold to housing screws (with washers) loosely (4 of M10-1.5 x 90mm, 5 of M10-1.5 x 65mm and 11 of M10-1.5 x 45mm. Loosen the dowel pin nuts on the manifold. Drive the dowel pins [3] into the housing to locate the manifold properly on the transmission housing. Tighten the manifold screws to 46 N•m (34 lb•ft).

6. Install the primary shaft rear bearing cup [4]. Install the secondary shaft rear bearing cup [5].

7. Lightly press the primary and secondary shaft rear bearing cups into position on the bearing cones with tool T-21482-31.

AAR273 AAR271

Figure 175. Install Dowel Pins (3) and Bearing Cups (4 and 5)

Adjust Primary Shaft Bearing Clearance

1. Measure the depth [6] of the primary shaft tapered roller bearing cup in the transmission housing. Measure from the machined surface of the transmission housing to the rear surface of the tapered roller bearing cup.
   Measure in three locations around the circumference of the bearing bore. The three readings should be identical. If the dimensions are not identical, realign the bearing cup. Record this dimension.

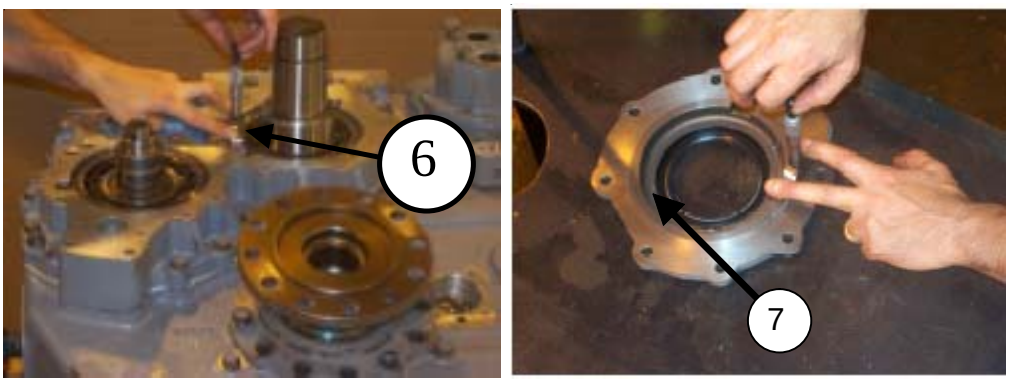
   Bearing Bore Depth = _____

2. Measure the length of the primary shaft rear cover pilot [7] and bearing spacer. Measure from the bearing contact point to the rear mounting surface of the cover.
   Measure in three locations around the circumference of the rear cover. The three readings should be identical. Record this dimension.

   Rear Cover Pilot Dimension = _____

3. Calculate the correct shim pack required to set the primary shaft rear bearings.
   a. Subtract the primary shaft rear cover and spacer dimension from the transmission housing to rear bearing cup dimension.
      Bearing Bore Dimension - (Cover + Spacer Dimension) = Pinion Shaft Clearance.
   b. Calculate the shim pack thickness required to obtain -0.05 (preload) to +0.05 mm (-0.002 preload to +0.002 inches) clutch shaft clearance when the shim pack is installed.

4. The calculated shim pack will be installed on the primary shaft between the spacer and the rear cover.



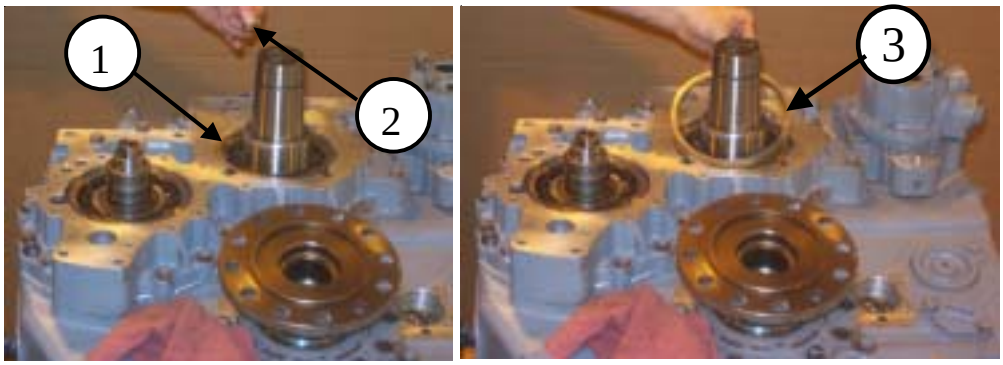
DCP 5759 DCP 5762

Figure 176. Measuring Components to Determine Primary Clutch Shaft Bearing Adjustment

Primary Shaft Cover Installation

1. Install O-rings [2] (clutch ports and lube ports) into the counter bores in the manifold housing.

2. Install the shim pack [3] on top of the Bearing Cup. Place the thickest shims on the outside of the shim pack and the thinnest shims in the center of the shim pack.



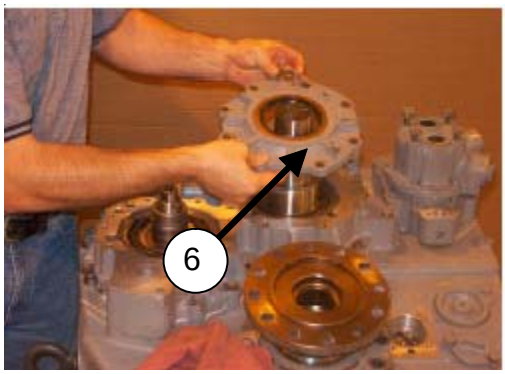
DCP 5766 DCP 5765 .

Figure 177. Primary Clutch Shaft Bearing Spacer (1), O-ring (2), and Shim (3) Installation

3. Lubricate the bore of the primary clutch shaft rear cover.

4. Place MA1015 on the sealing surface of the primary clutch shaft rear cover.

5. Install primary clutch shaft cover [6] (8 of M10-1.5x32mm with washers). Torque the screws to 46 N-m (34 lb-ft)



DCP 5768

Figure 178 . Seal (5) and Install Primary Clutch Shaft Cover (6)

Set Secondary Shaft Bearing Clearance

1. Measure the depth of the secondary clutch shaft tapered roller bearing cup in the transmission housing. Measure from the machined surface of the transmission housing to the rear surface of the tapered roller bearing cup.
   Measure in three locations around the circumference of the bearing bore. The three readings should be identical. If the dimensions are not identical, realign the bearing cup. Record this dimension.

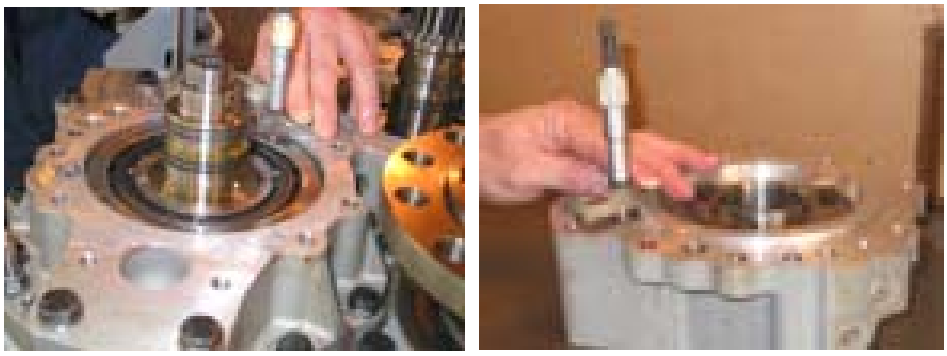
   Bearing Bore Depth = _____

2. Insert the bearing spacer in the bore of the pump mount. Measure the length of the spacer that is beyond the mounting surface of the cover. Measure in three locations around the circumference of the pump mount. The three readings should be identical. Record this dimension.

   Pump Mount Pilot Dimension = _____

3. Calculate the correct shim pack required to set the secondary clutch shaft rear bearings.
   a. Subtract the secondary clutch shaft rear cover dimension from the transmission housing to rear bearing cup dimension.
      Bearing Bore Dimension - (Cover Dimension) = Pinion Shaft Clearance.
   b. Calculate the shim pack thickness required to obtain -0.05 preload to +0.05 mm (-0.002 preload to +0.002 inches) clutch shaft clearance when the shim pack is installed.

4. The calculated shim pack will be installed on the secondary clutch shaft between the bearing cup and the spacer.



1049BE 1045BE

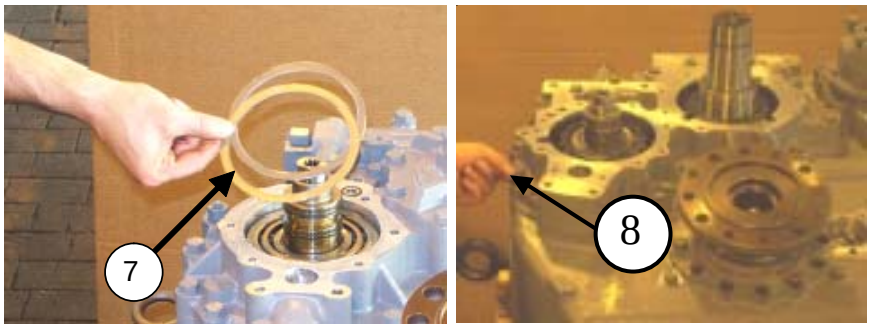
Figure 179. Measuring Components to Determine Secondary Clutch Shaft Bearing Adjustment

Pump Mount Installation

Note: Verify that sealing rings are installed on the secondary shaft before installing the pump mount.

1. Install the secondary shaft shim pack [7] on top of the rear bearing cup. Place the thickest shims on the outside of the shim pack and the thinnest shims in the center of the shim pack.

2. Install the secondary shaft O-rings into the counter bores [8] in the manifold housing.



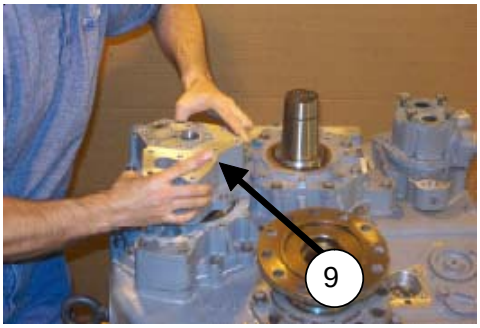
DCP 0136 DCP5753

Figure 180. Secondary Clutch Shaft Bearing Shim (7) and O-ring (8) Installation

3. Place MA1015 on the sealing surface of the pump mount (secondary shaft rear cover).

Note: Place sealant on the sealing surface of the pump mount and pump suction port.

4. Install the pump mounting [9] cover (secondary shaft rear cover) (4 of M10-1.5 x 115mm, 1 of M10-1.5 x 100mm, 1 of M10-1.5 x 35mm, 1 of M10-1.5 x 60mm and 1 of M10-1.5 x 45mm, all with washers). Torque the screws to 46 N•m (34 lb•ft).



DCP 5775

Figure 181. Seal and Install Pump Mount (9)

Transmission External Components

Pump and Suction Screen Installation

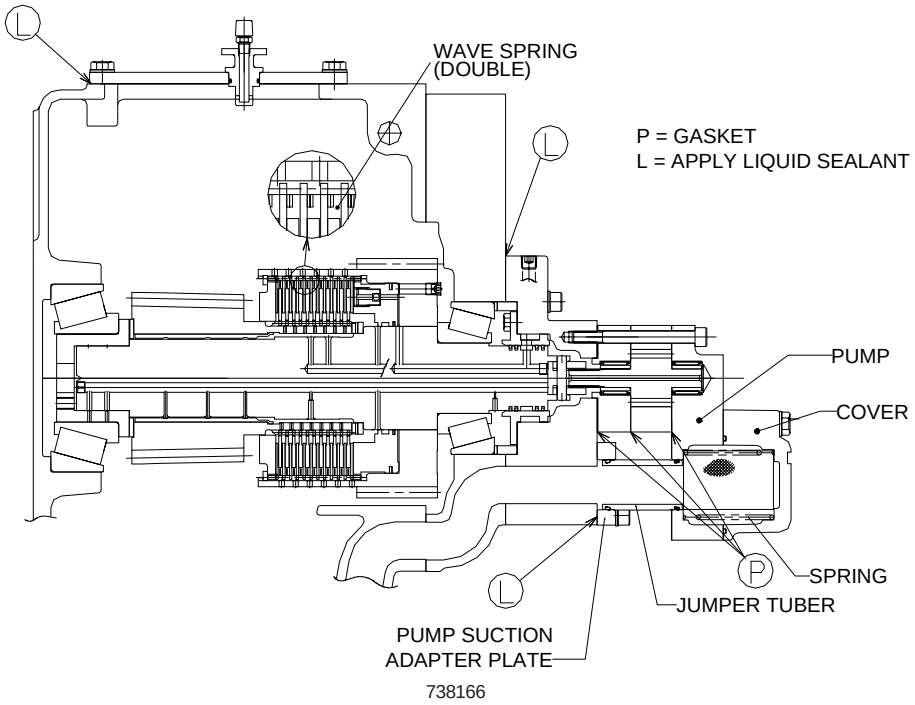


Figure 182. Pump Component Identification and Location

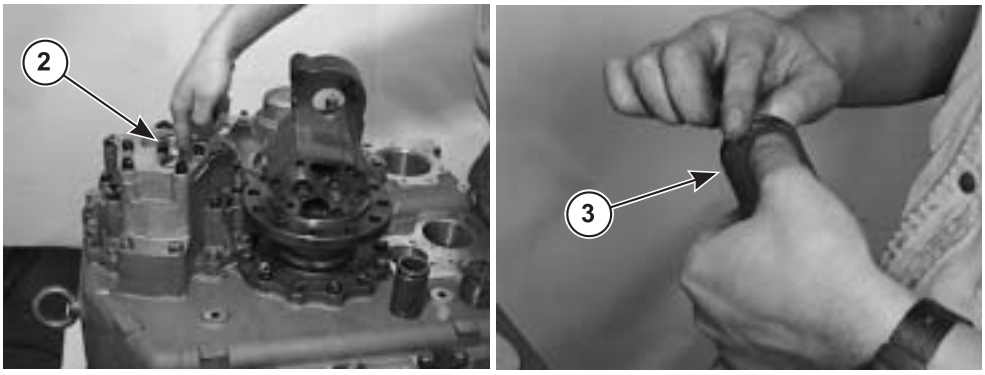
1. Place MA1015 sealant on the sealing surface of the pump suction adapter plate.

2. Install the pump suction adapter plate [1] (if removed). Torque the screws to 46 N•m (34 lb•ft).

Figure 183. Seal and Install Pump Suction Adapter Plate (1)

3. Lubricate the pump suction jumper tube bore [2].

4. Install O-rings on each end of the pump jumper tube [3]. Lubricate the O-rings.

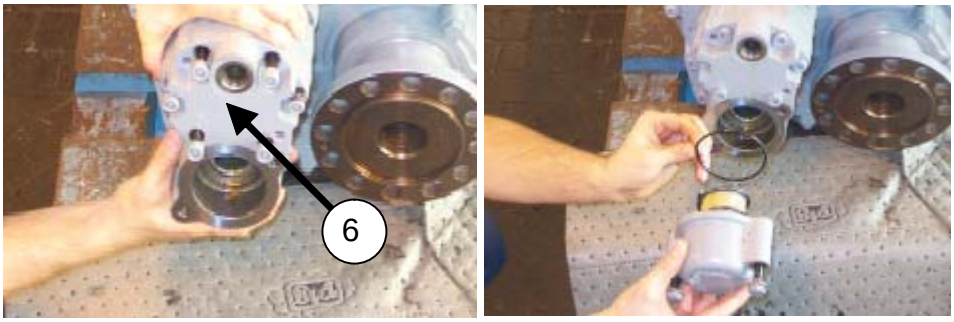


AAR288 AAR289

Figure 184. Jumper Tube (3) Lubrication

5. Install the jumper tube into the pump suction adapter plate.

7. Install the jumper tube [5] and the pump [6]. It may be necessary to rotate the primary shaft to allow the pump shaft to align during installation. Torque the screws to 46 N•m (34 lb•ft).



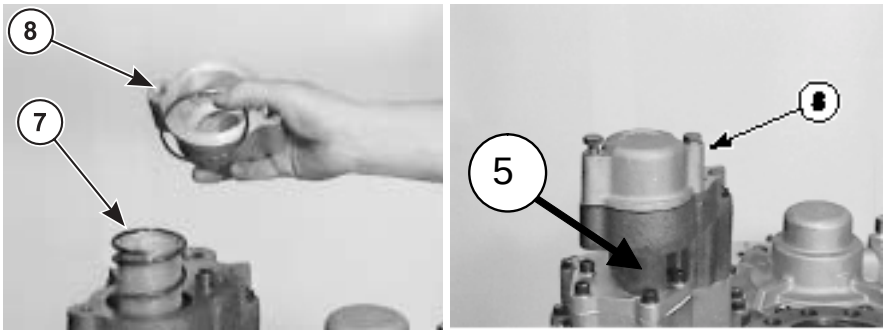
DCP 0125 DCP 0124

Figure 185. Pump (6) Installation

8. Install the suction strainer [7].

9. Install the suction strainer O-ring and cover [8]. Torque the screws to 45 N•m (33 lb•ft).

   Note: Do not crush the suction strainer.



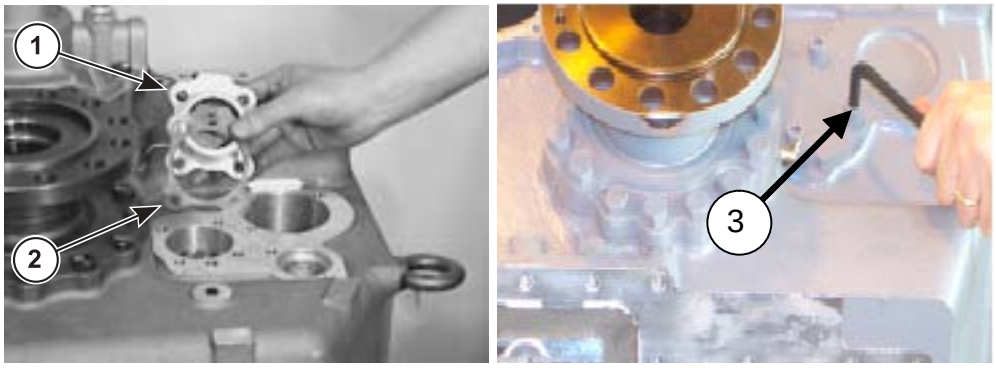
AAR295 AAR296

Figure 186. Suction Strainer (7) and Cover (8) Installation

Trailing Pump Cover Installation

1. Install the trailing pump cover [1] and gasket [2]. Torque the screws [3] to 46 N•m (34 lb•ft).

Note: If the transmission is equipped with a trailing pump, install the suction screen into the housing.



AAR298 DCP 0165

Figure 187. Trailing Pump Cover (1) and Gasket (2) Installation

Heat Exchanger Installation

Heat exchangers furnished by Twin Disc to be used in salt water applications have zinc anode rods installed at the heat exchanger inlet and outlet heads. These rods must be checked every 90 days. If over 50% of the rod is disintegrated, it should be replaced to provide effective protection.

Excessive corrosion of the zinc anode rod indicates electrolytic action. A careful inspection should be made to determine if this action is caused by a short circuit or externally grounded electrical current. If these conditions do not exist, it is evident the corrosion is due to local electrolysis.

If the zinc anode rods are corroded with foreign materials, they should be cleaned with a wire brush.

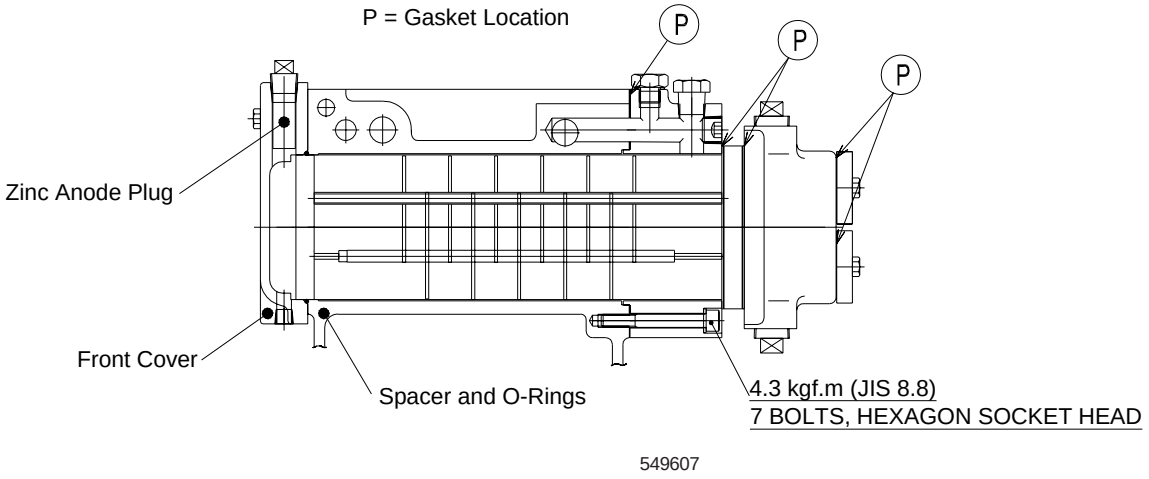
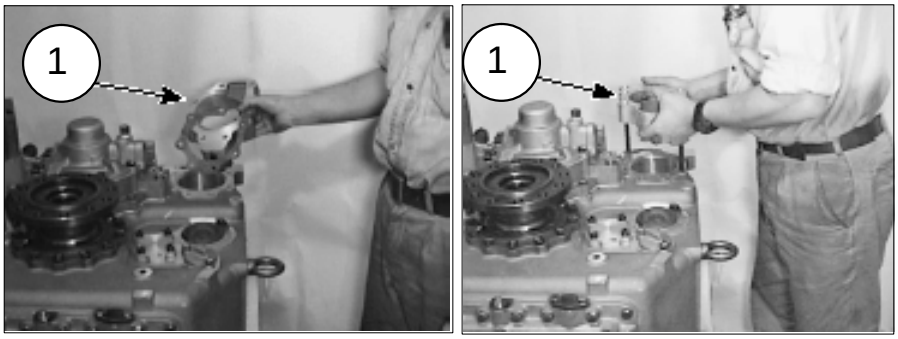


Figure 188. Heat Exchanger Component Identification and Location

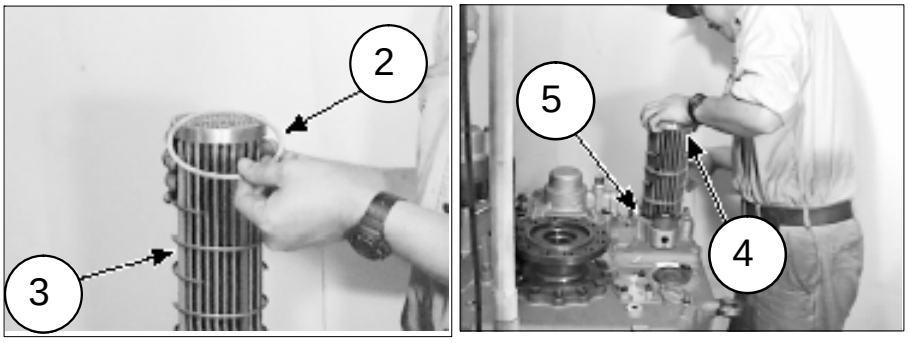
1. Install the heat exchanger base [1] and gasket if removed. Torque the mounting screws to a value of 46 N•m (34 lb•ft).



AAR302 AAR305

Figure 189. Heat Exchanger Adapter Plate Housing (1)

2. Install the gasket [2] and heat exchanger [3]. The gasket is placed between the flange [4] on the heat exchanger and the base [5].



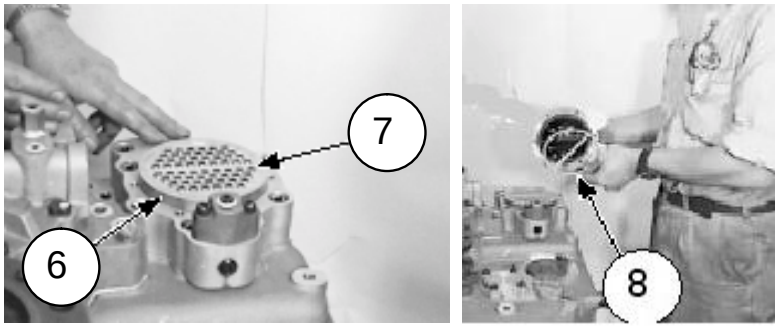
AAR306 AAR308

Figure 190. Heat Exchanger Gasket (2) and Core (3) Installation

3. Install the heat exchanger [6] with the mark made during disassembly at the top.

   Place the heat exchanger into the transmission housing with the divider [7] located horizontally in the housing. The divider in the heat exchanger, along with the rear cover [8], separates the inlet from the outlet of the heat exchanger.

   Note: If the heat exchanger is not properly installed in the transmission housing, the transmission could overheat.



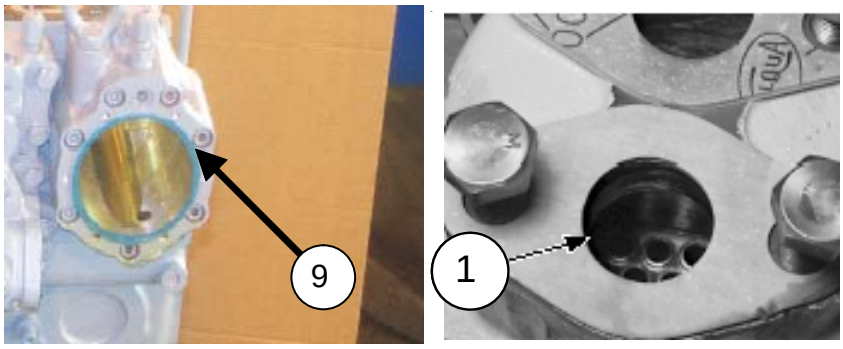
AAR309 AAR311

Figure 191. Heat Exchanger Core (6) Placement

4. Apply grease between the rear cover and gasket of the heat exchanger. The heat exchanger gasket [9] is attached to the rear cover mounting of the heat exchanger.

   Install the heat exchanger rear cover. The heat exchanger positioning can be verified by viewing the heat exchanger through the inlet/outlet ports [1]. The divider should not be out of position when viewed through the inlet/outlet ports. Torque the screws evenly to 38 N•m (28 lb•ft). (6 of M8 x 50mm, no Washer)

   Note: Improper tightening of the heat exchanger rear cover could cause damage to the cover.



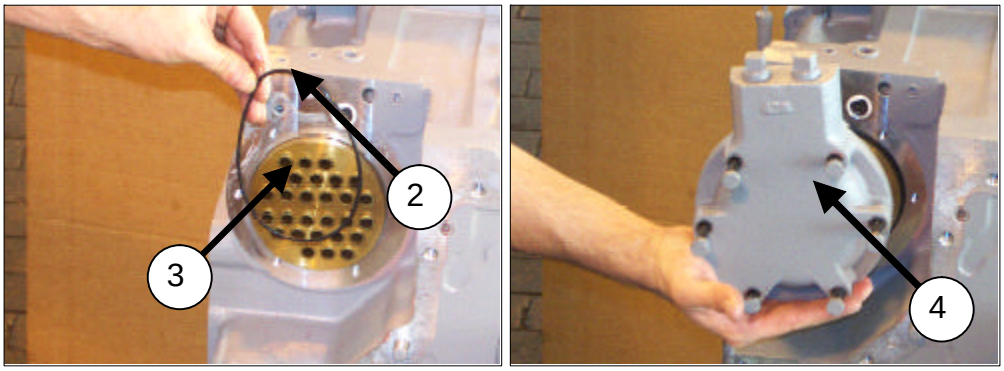
DCP 0116 AAR313

Figure 192. Heat Exchanger Cover and Gasket Installation

5. Place the transmission housing in the upright position.
   a. Lubricate, then install an O-ring [2] over the front of the heat exchanger [3].

6. Place the screws into the front cover [4] of the heat exchanger. Install the front cover over the heat exchanger. Tighten the heat exchanger cover screws evenly to a torque of 38 N•m (28 lb•ft). (6 of M8 -1.5 x 55mm, no washer)

Note: Tighten the six screws evenly to prevent damage.

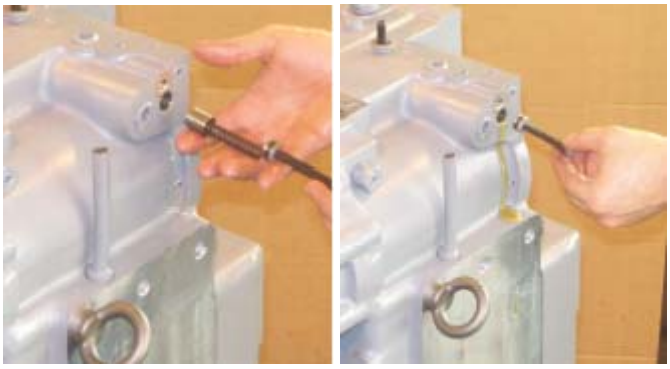


DCP 0107 DCP 0105

Figure 193. Heat Exchanger Front Seals (2) and Front Cover (4)

Cold Oil Relief Valve Installation

1. Install the cold oil relief valve



DCP 0129 DCP 0130

Figure 194. Cold Oil Relief Valve

Assembly and Installation of Control Valve

Assembly of Electrical Control Valve (upper body half)

1. Install one dowel pin (large diameter) into each of the two bores of the valve body.

2. Install one spring into each of the two bores of the valve body.

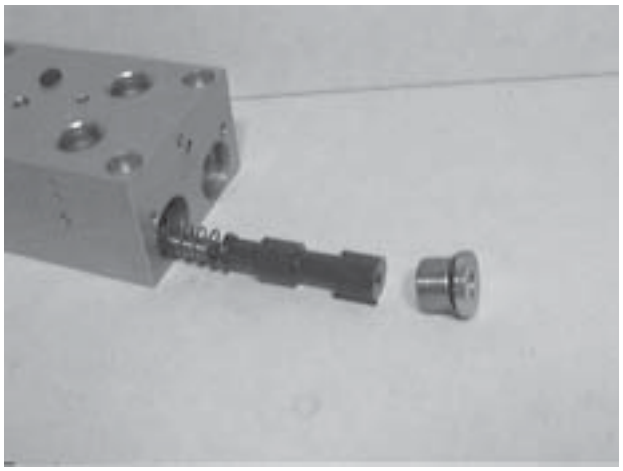


Figure 195. Dowel, Return Spring, Spool, and Plug

3. Install one spool into each of the two bores of the valve body.

4. On units equipped with the hydraulic lock feature, install one spring followed by one pin (small diameter) into each of the spools.

5. Install the two O-ring plugs into the valve body and tighten to 85 N•m (63 lb•ft.)

6. Apply lubricant (such as Dow Corning® 200® 30,000 cSt fluid) to the O-rings of the solenoids and plug (plug used on units without hydraulic lock). Install solenoids (and plug, if equipped) into the valve body and torque them to 34 N•m (25 lb•ft.).

7. Insert the wires (pins) into the Weatherpak® connector according to the location markings made at disassembly. Close the end of the Weatherpak® connector to lock the wires in position.

8. Install the Weatherpak ® connector onto its retaining clip on the top of the valve body.

Assembly of Electrical Control Valve (lower body half)

1. Install the steel shuttle ball into its bore in the valve body.

2. Install the O-ring onto the shuttle ball seat.

3. Apply lubricant such as Dow Corning® 200 30,000 cSt fluid to the O-ring, and install the seat into the valve body. Be sure to align the roll pin holes in the seat with the holes in the valve body. One of the valve's M8x1.25 cover screws threaded into the seat can be used to adjust the seat location in the valve body.

4. Install the roll pin to retain the shuttle ball seat. Drive the roll pin in until it is flush with the gasket surface of the valve body.

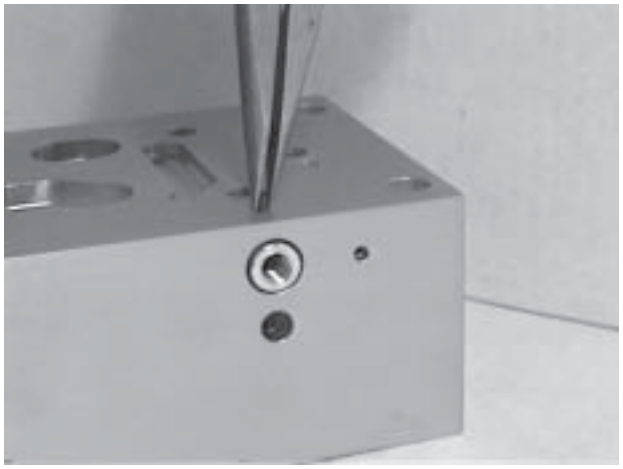


Figure 196. Installing Shuttle Ball Seat Roll Pin

5. Install the stem into the valve body, aligning the slot in the stem with the threaded hole in the valve body for the dog-point setscrew. Be sure the slot in the stem is aligned with the setscrew hole in the valve body to prevent damage to the stem and valve body.

6. Apply MA908 threadlocker to the threads of the dog-point setscrew and install. Tighten the dog-point setscrew until snug, then back off 1/2 turn.

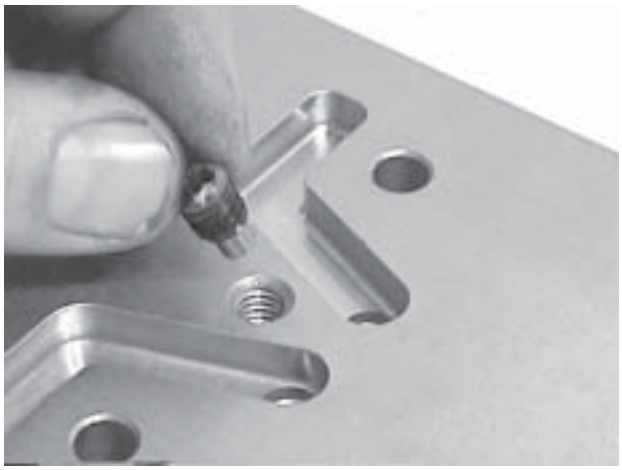


Figure 197. Installing Dog-point Setscrew

7. Install the steel detent ball into the valve body.

8. Install the detent spring over the detent ball.

9. Apply MA908 threadlocker to the threads of the hollow setscrew and install into the threaded hole. A stepped Allen wrench, or one wrapped with tape will ease the installation of the hollow setscrew. Tighten the setscrew until it is flush with the gasket surface of the valve body. Check the stem rotation and detent action.

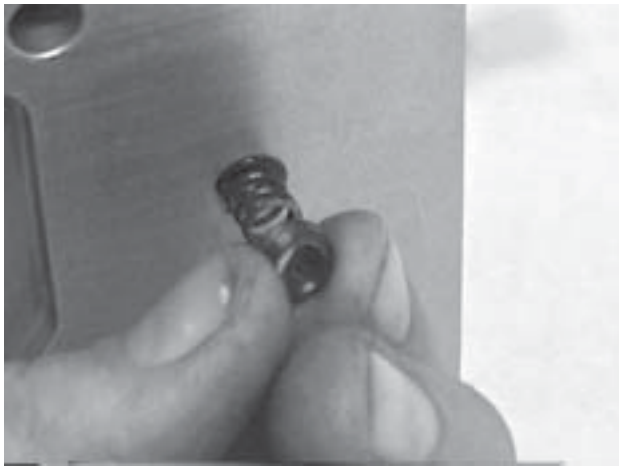


Figure 198. Installing Detent Ball Setscrew

10. Install the thrust washer over the end of the stem.

11. Press the oil seal into the cover assembly until flush with the adjacent cover surface.

12. Install the O-ring into the counterbore in the cover assembly.

13. Apply grease to the stem, O-ring, and oil seal lip.

14. Install cover assembly and gasket onto valve body. Be sure to align the oil drain hole in the gasket with the hole in the valve body.

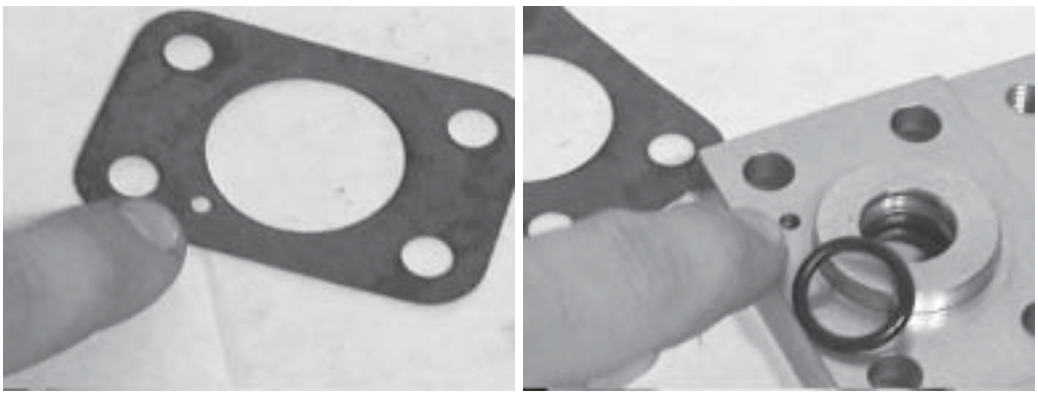


Figure 199. Holes in Gasket and Cover Must be Aligned

15. Install cover capscrews and torque to 23 N•m (17 lb•ft).

16. Install washer over stem and against oil seal.

17. Install spring over stem against washer.

18. Install lever onto the stem. It may be necessary to splay the lever to be able to install it. **DO NOT** apply any impact force to the lever, as the stem or dog-point setscrew may be damaged. Torque the lever's attaching screw to 9.5 N•m (7 lb•ft).

19. Install external retaining ring onto stem .

20. Install the steel balls and electrical switches into the bores in the sides of the valve body (if equipped). Note that the small diameter ball is inboard of the large diameter ball at each switch location.

21. Install the pressure regulating piston into valve body with spring pocket out.

22. Install pressure regulating springs into valve body and into piston spring pocket.

23. Install the shims that were removed into the bore of the rate-of-rise piston. Install the rate-of-rise piston over the springs and into valve body. Install screen into passage.

24. Install neutral pressure regulating spring into the pocket of valve body.

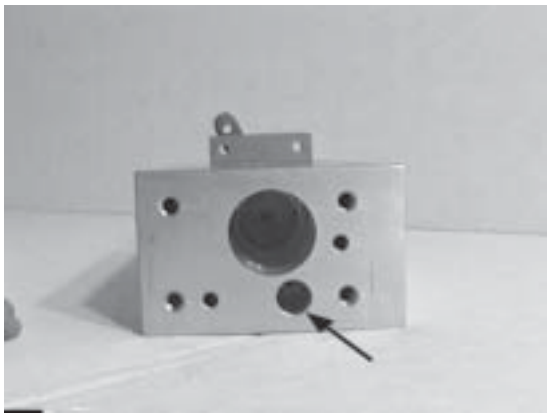


Figure 200. Neutral Pressure Regulating Spring Location

25. Install orifice plate gasket onto valve body.

26. Install orifice plate and steel ball (against spring) onto valve body.

27. Install orifice plate cover and gasket onto valve body. Install cover capscrews and torque to 23 N•m (17 lb•ft).

28. Install gasket over lower valve body half.

29. Set upper valve body half over lower valve body half. Insert the valve attaching screws through valve body halves to keep parts in alignment until installation onto the transmission. When installing the valve onto the transmission, torque the screws to 54 N•m (40 lb•ft).

Trolling Valve (Optional Equipment)

1. Install the pipe plugs, bushings and internal retaining ring (if removed) into the valve.

2. Install the piston into the bushings of the valve. Note that the small diameter end of the piston will protrude past the bushing at the opposite end of the valve when installed properly.

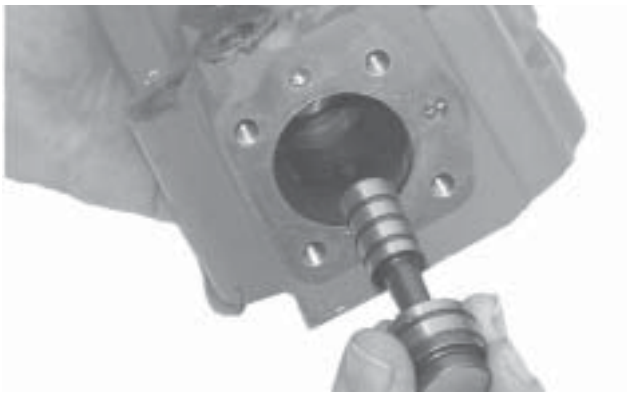


Figure 201. Install piston

3. Install the washer over the shoulder of the piston in the valve.

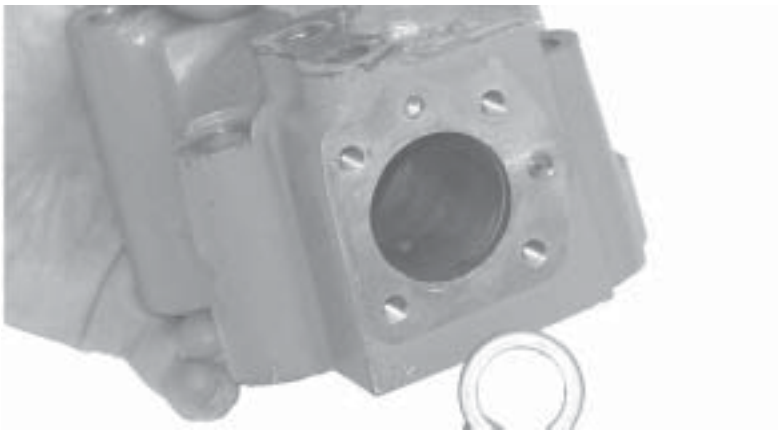


Figure 202. Install washer

4. Install the large diameter spring over the washer in the valve.

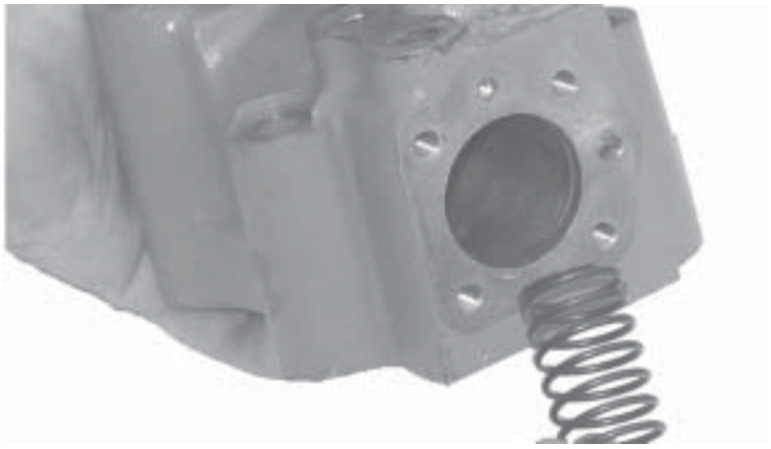


Figure 203. Install spring

5. Place the shim(s) into the bore of the piston assembly. Install the piston assembly into the bore of the valve.

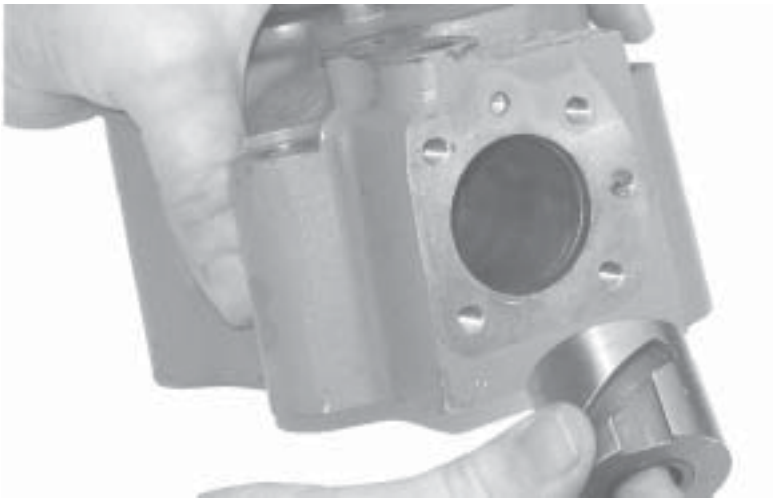


Figure 204. Install piston assembly

6. Install a new O-ring into the groove of the shaft. Apply grease to the bore of the cover and the shaft and insert the shaft through the cover. Install the “E” retaining clip onto the shaft.

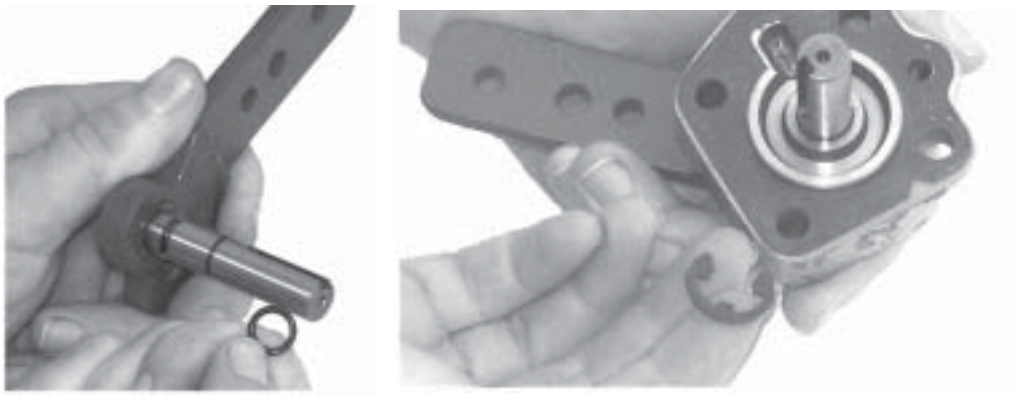


Figure 205. Install o-ring and clip

7. Place the detent ball into the pocket in the cover of the shaft/cover assembly. Apply grease to help keep the ball in place and prevent corrosion during service. Apply grease to the detent spring and place it into the pocket over the detent ball.

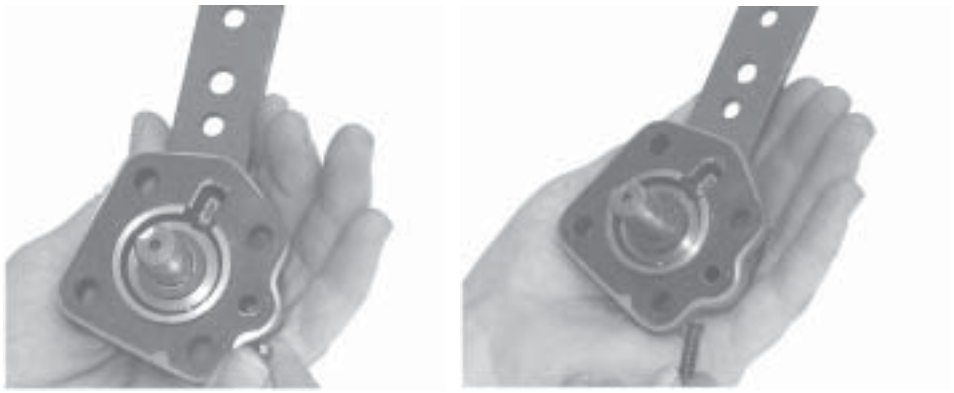


Figure 206 Assemble detent ball and spring

8. Install the cover and shaft assembly and gasket onto the valve. Be sure to align the keyway in the shaft with the pin in the piston assembly. Also, be sure to align the detent spring hole in the cover and gasket with the detent spring pocket in the valve.

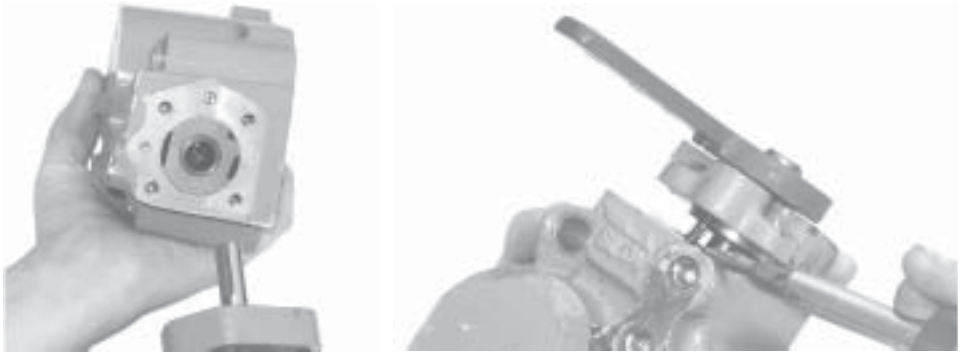


Figure 207. Install shaft assembly with cover

9. Install the three loose cover socket head capscrews into the proper locations (long and short screws). Rotate the handle to the minimum trolling pressure position, and install the last screw. Torque the cover attaching screws to 9.5 Nm (7 ft-lb).

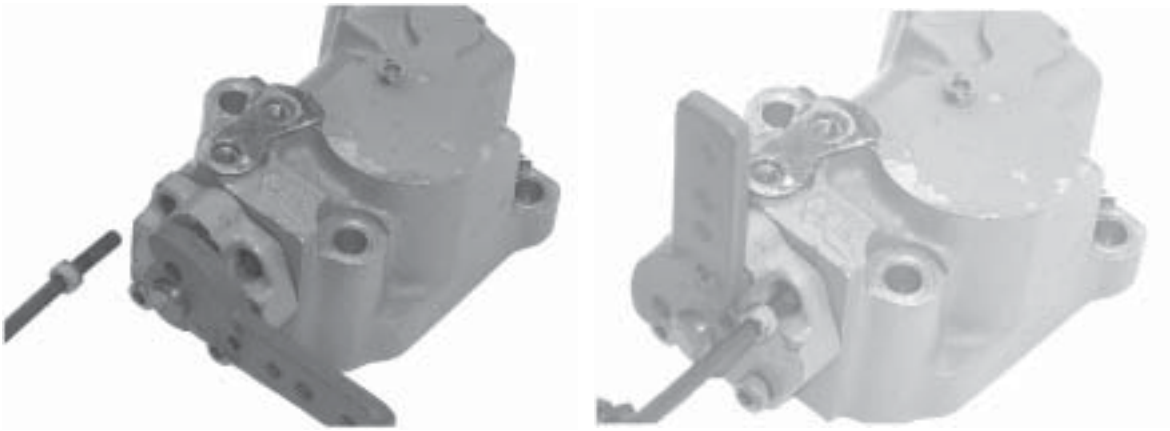


Figure 208 Install screws

10. Place the small diameter spring into the pocket of the end cover. Use a small amount of grease to retain the spring in the cover.

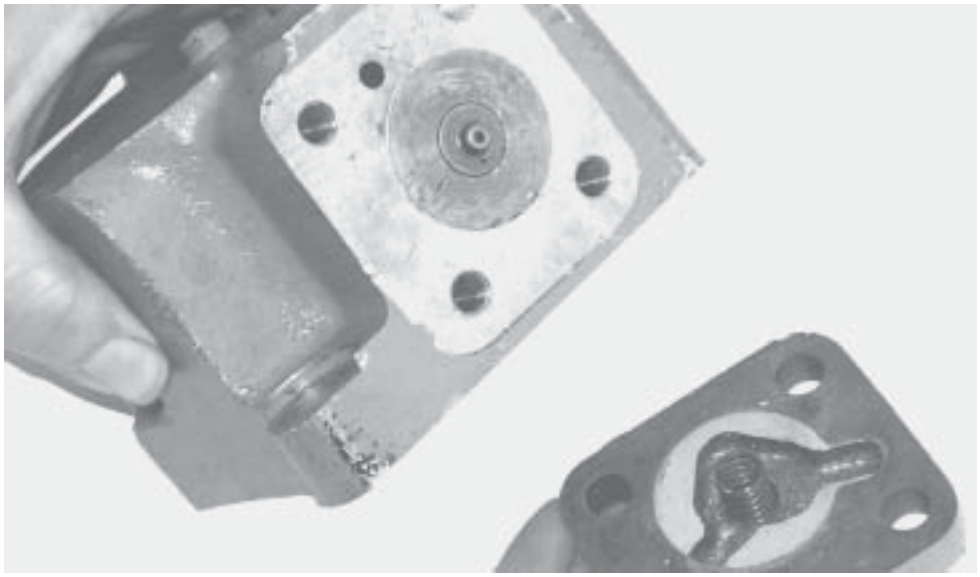


Figure 209. Install spring and rear cover

11. Install the cover (being careful not to drop the small spring) and gasket. Install the hex head capscrews and torque them to 23 Nm (24.5 ft-lb).

Trolling valve installation

1. Install the gasket and lower valve body half onto the transmission.

2. Install the ditch plates and gaskets onto the lower valve body half.

3. Install the socket head capscrews through the ditch plates, valve body, and into the transmission. Torque the screws to the specification **listed on the valve installation drawing**.

4. Install the upper valve body half and gasket onto the ditch plates. Torque the screws to the specification **listed on the valve installation drawing**.

5. Install the trolling valve and gasket onto the ditch plate and torque the screws to specification (see Torque Chart).

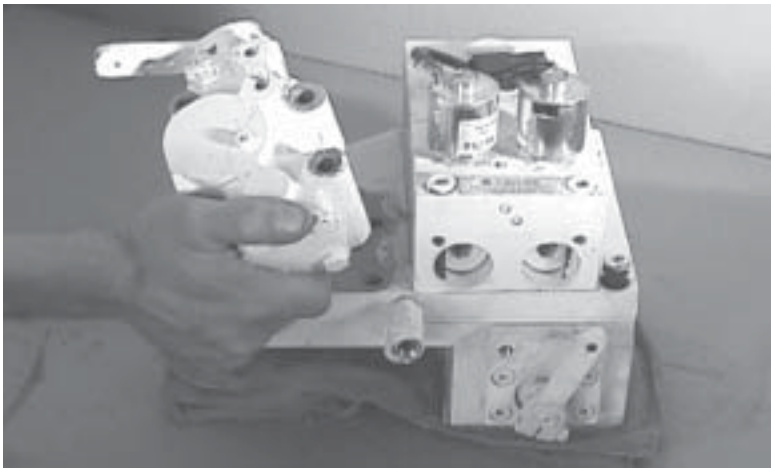


Figure 210. Install trolling valve onto ditch plate

Assembly of GP Control Valve with Electronic Interface

Prior to assembly, all parts must be properly cleaned. Carefully inspect all o-rings for any damage, and replace as necessary. Lubricate all o-rings, and replace both gaskets.

1. **Valve Assembly 1020729**: Assemble the Main Regulator Valve body.

   A. Install the Main Pressure pilot relief valve into the valve body and torque to 27 Nm (20 Ft-lb).

   B. Install the Main Valve into the valve body and torque to 33 Nm (24 Ft-lb).

   C. Install the 3/8 nptf pipe plug or optional temperature sensor into the valve body and torque to 23 Nm (17 Ft-lb).

   D. Install the M27x2.0 o ring plug into the valve body and torque to 75 Nm (55 Ft-lb).

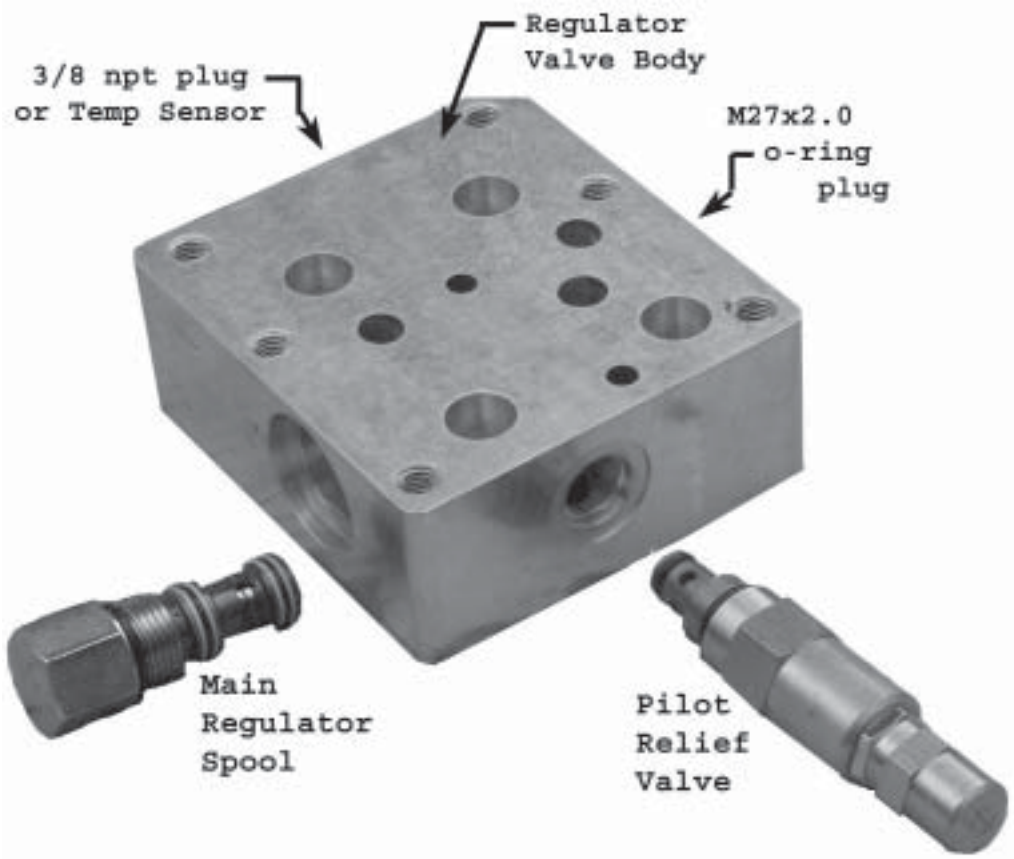


Figure 211. Main Pressure Regulator Components Assembly 1020729

1. **Valve Assembly 1021658**: Assemble the Main Regulator Valve body.

   A. Install the filter into the threaded hole of the valve body, and torque to 7.5 Nm (5.5 Ft-lb). If removed, install a new check valve assembly into the bore of the valve body, and drive it with a drift until it is flush with the face of the body. Install the 3/8 nptf pipe plug or optional temperature sensor into the valve body and torque to 23 Nm (17 Ft-lb).

   B. Install the gasket and cover without the adjustment screw to the valve body with four M8 x 20 capscrews and torque to 23 Nm (17 Ft-lb).

   C. Install the spool with washer, and spring into the bore. Install the gasket, and cover with the adjustment screw, using four M8 x 25 capscrews. Evenly tighten the capscrews, and torque to 23 Nm (17 Ft-lb).

   D. Install the cap onto the adjusting screw finger tight as the main pressure must be set at the time of installation or testing.

Figure 212. Assemble Main Pressure Regulator Components

2. Assemble the Top Valve Body. Install the two proportional valve assemblies into the valve body, install the retaining plate, and torque the M6-1.00 x 16 socket head capscrew to 9.5 Nm (7 Ft-lb). Install the Manual Direction Control Valve into the valve body, and torque to 27 Nm (20 Ft-lb). Install the M12 x 1.50 o-ring plug into the valve body and torque to 16 Nm (12 Ft-lb). Connect the wires for the Neutral Switch.

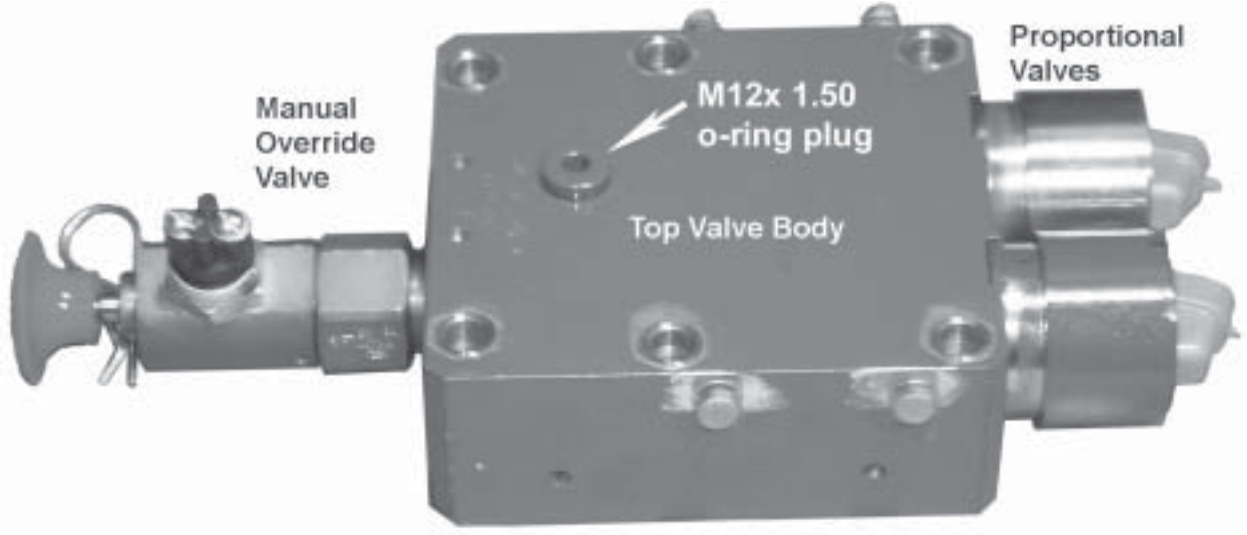


Figure 213. Assemble Top Valve Body Components

3. Install a new gasket, and the Main Regulator Valve Assembly to the transmission or ditch plate, using the four twelve point capscrews. Torque the capscrews to the level specified for the appropriate sized capscrew into aluminum threads. See the torque specifications in Description and Specifications.

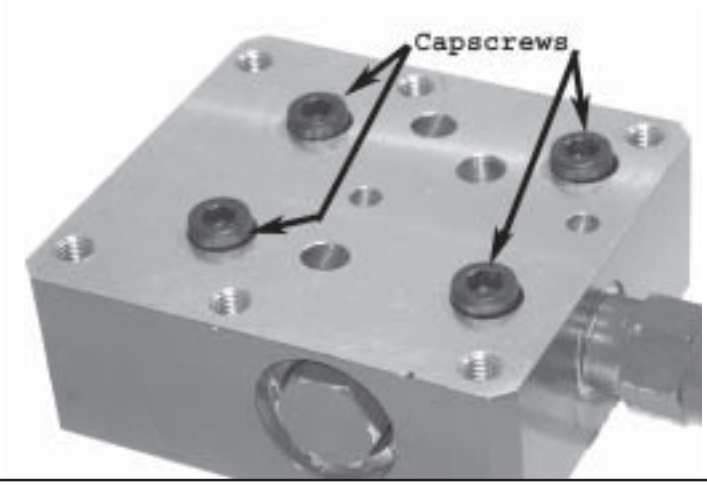


Figure 214. Install Regulator Valve Body to Transmission

4. Install a new gasket, and the Top Valve Body Assembly on the Main Regulator Valve Assembly, using six M10-1.50 x 70 hex head capscrews, and torque to 46 Nm (34 Ft-lb).

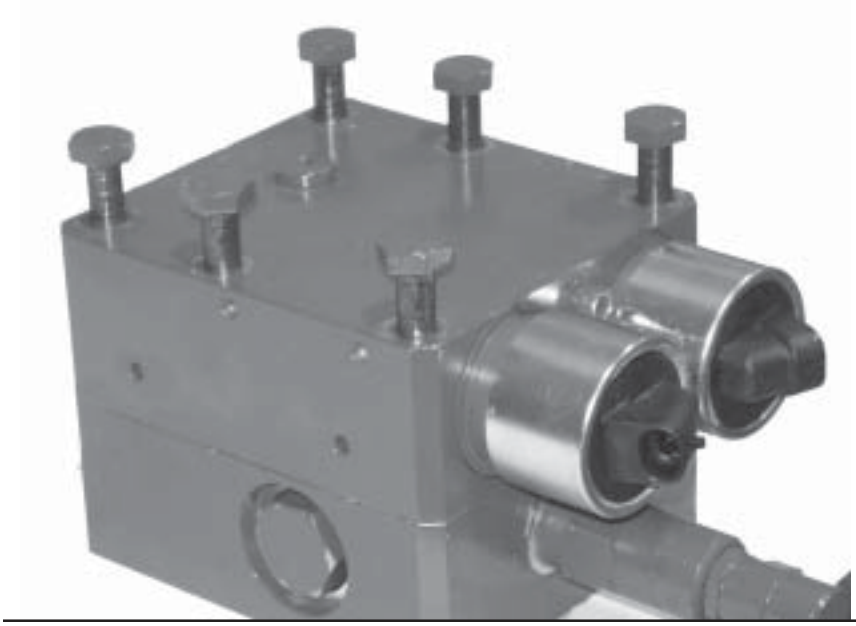


Figure 215. Install Top Valve Body onto Regulator Valve Assembly

5. Install the Electronic Profile or E-Troll Module on the top Valve Body, and torque the four M6-1.0 capscrews to 9.5 Nm (7 Ft-lb).

Figure 216. Place Profile or E-Troll Module onto Valve and tighten screws

6. Connect the electrical wires to the proportional valves, and connect any other wires that were removed during disassembly.

Adjustment of Main Pressure

Valve Assembly 1020729: It is recommended that following the servicing of the GP Valve Assembly off of the transmission that a procedure be followed to ensure the flushing of oil through the valve assembly, followed by adjustment of the main pressure.

1. Install a main pressure gauge into the port on top of the Top Valve body.

2. Remove protective cover cap located at the end of the cartridge. This will expose a 1/4" hex head adjustment stem. Loosen the jam nut on the stem.

Figure 217. Pilot Relief Valve Assembly

3. Turn this adjustment stem counterclockwise until it reaches a positive stop. This allows the engine/transmission to be started and flush any debris past the relief valve.

   Note: This must be done with the transmission in Neutral.

4. Start engine with controls in neutral. Main pressure should be approximately 100 psi or less. Allow the fluid to flush the valve for approximately 1 minute.

5. Turn the 1/4" hex head adjustment stem clockwise to achieve the main pressure setting. A helpful practice is to turn the adjustment stem slightly beyond the desired setting (approximately 5 psi) and then adjust for the target pressure. This aids in reducing variance in pressure setting due to torsional wind-up of the spring.
   Note: If main pressure is to be set with cold oil, adjust the main pressure approximately 5 to 10 psi higher than the desired value with hot oil.

6. Tighten the jam nut to a torque of 20 Nm (15 Ft-lb), install the protective cap, and torque it to 14 Nm (10 Ft-lb)

Valve Assembly 1020729:

1. Install a main pressure gauge into the port on top of the Top Valve body.

2. Remove protective cover cap located at the end of the adjusting stem. This will expose a slotted adjustment stem. Loosen the jam nut on the stem.

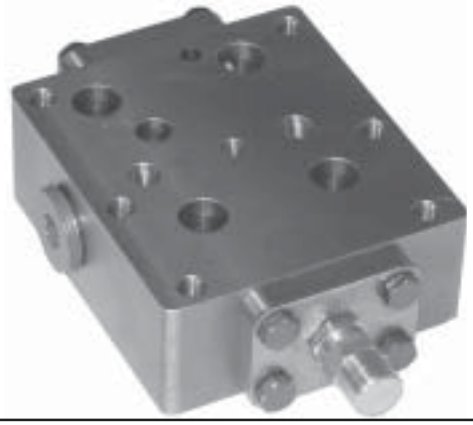


Figure 218. Main Pressure Regulating Valve Assembly 1021658

3. Start engine with controls in neutral.

   Note: This must be done with the transmission in Neutral.

4. Turn the slotted adjustment stem clockwise to achieve the main pressure setting. See the specifications in Description and Specifications.

5. Tighten the jam nut to a torque of 20 Nm (15 Ft-lb), install the protective cap, and torque it to 14 Nm (10 Ft-lb)

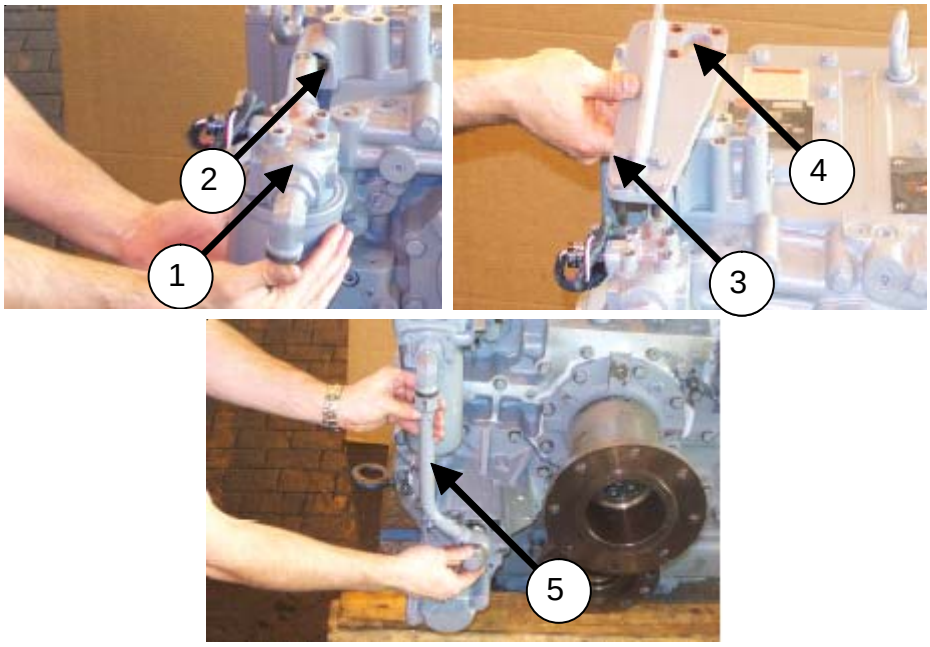
Oil Filter Housing Installation

1. Install the oil filter assembly [1]. Push the 2 O-Rings sealed tube which is holding the filter into the housing hole [2]

2. Install the bracket above the filter (4 x M10 X 24mm at [3]) and (4 x M10 x 90mm at [4])

3. Install the piping assemblies on the transmission.
   a. Pump to filter. [5] (Banjo fitting with copper washer)

Note: See specification section for tubing and banjo fitting torque values.



DCP 0121 DCP 0120 DCP 0117

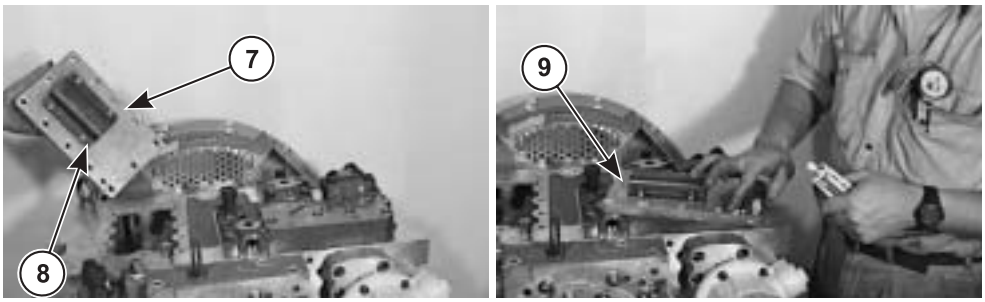
Figure 219. Oil Filter (1) Installation

Transmission Top Cover and Oil Level Gauge Installation

1. The top cover [7] of the transmission housing should be installed with the oil baffle [8] towards the rear of the transmission housing.

   Note: The oil baffle attaching studs are sealed with Loctite® Threadlocker 277 or equivalent. The oil baffle retaining nuts are retained with Loctite® 242 or equivalent.

2. Place MA1015 sealant on the sealing surface [9] of the transmission housing and top cover.

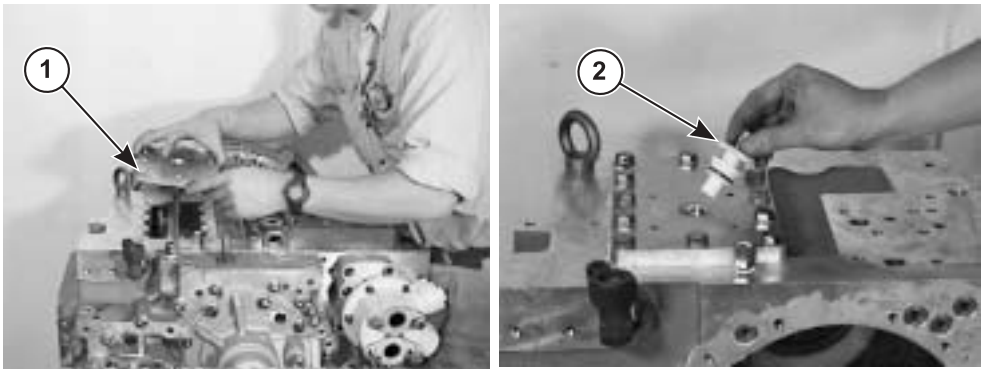


AAR324 AAR326

Figure 220. Seal Top Cover (7)

3. Install the top cover [1] on the transmission housing. Tighten the screws to 45 N•m (33 lb•ft).

4. Lubricate the sealing ring of the oil filler cap [2] and install it in the top cover of the transmission.



AAR327 AAR164

Figure 221. Install Top Cover (1) and Filler Cap (2)

5. Install the oil level gauge tube into the housing (if removed). Place tool T-21578-2 [3] over the top of the oil level gauge tube and gently tap the oil level gauge tube into the transmission housing.

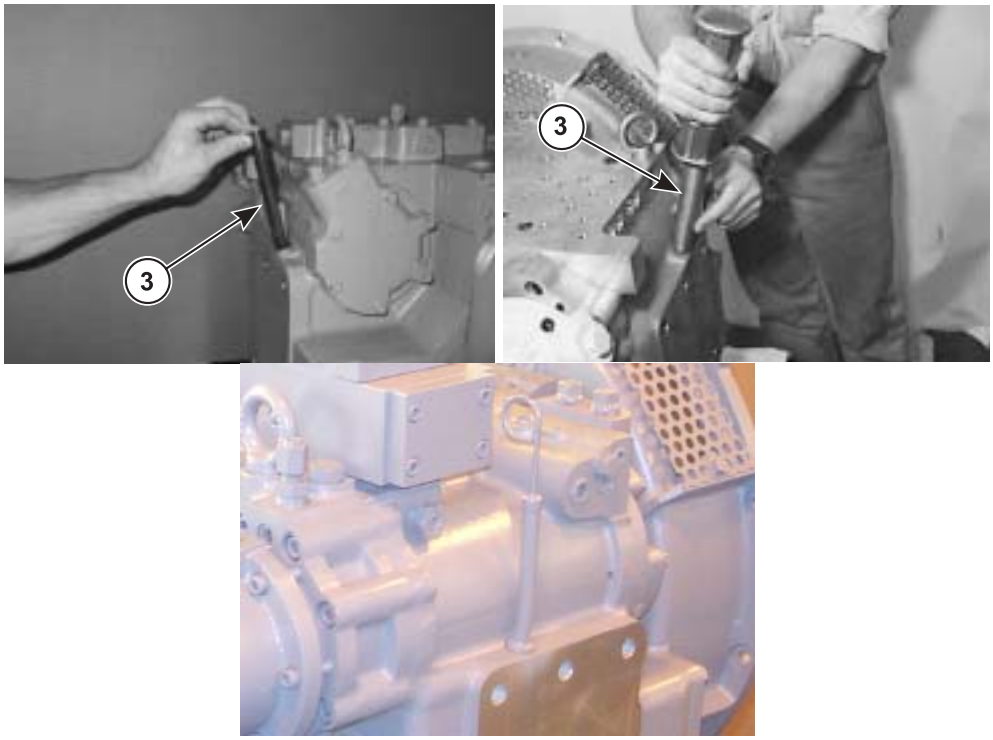


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Figure 222. Using Tool T-21578-2 to Install Oil Level Gauge Tube

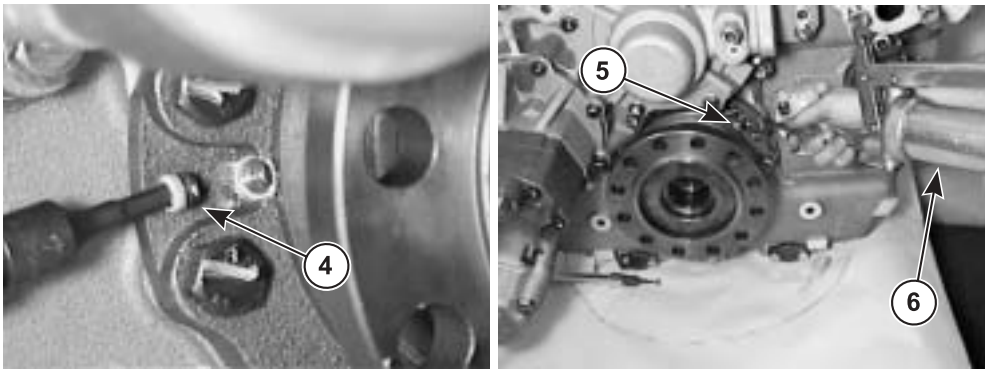
Grease Output Shaft Seals

Fill the cavity between the two (single lip and double lip) output shaft seals with grease as follows.

a. Remove the pipe plug [4] on the output shaft seal retainer housing. The pipe plug is located on the opposite side (180° opposed) of the grease zerk fitting [5] on the housing. The pipe plug provides a place for air to escape while greasing the seal cavity.

b. Use a grease gun [6] to fill the cavity with grease. When grease escapes the seal retainer through the pipe plug opening, the cavity is filled.

c. Reinstall the pipe plug.



AAR328 AAR329

Figure 223. Grease Output Shaft Seals

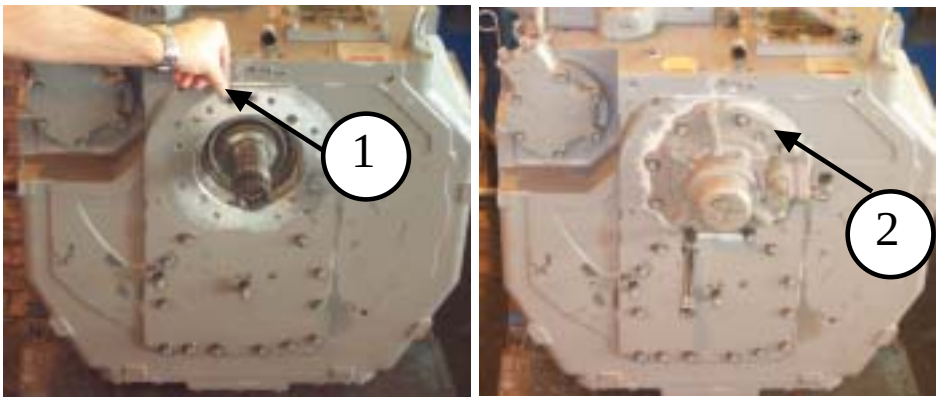
Primary and Output Shaft End Cover Installation

Note: Be sure sealing rings are installed on primary shaft before installing cover.

1. Place MA 1015 sealer on the sealing surface of the primary end cover.

2. Install the O-rings [1] in the counterbore of the transmission housing

3. Install the primary end cover [2]. Torque the M10 capscrews to 46 Nm (34 lb.ft).



DCP0069 DCP0075

Figure 224 Install O-rings [1] and Primary End Cover [2]

4. Place MA1015 sealer on the sealing surfaces of the output shaft front cover.

5. Install the output shaft front cover. Torque the M10 capscrews to 46 Nm (34 lb.ft)

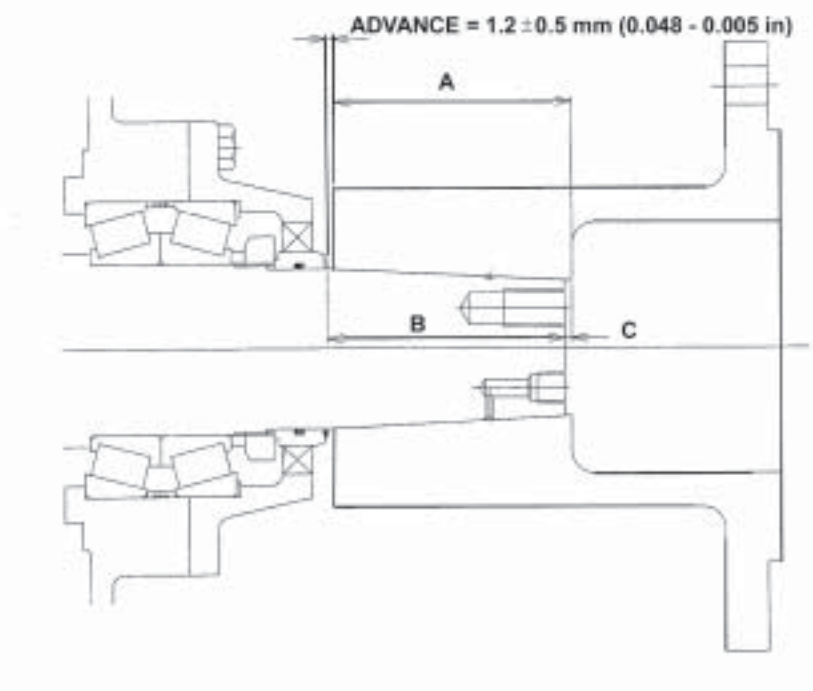
Install Input Flange and Fill Transmission with Oil

1. Determine the thickness of shims required to properly locate the input flange.

   a. Thoroughly clean the taper of the input flange and the input shaft.

   b. Measure distances A, B and C.

   c. Use the following formula to determine the correct thickness of shims (B + C) - (A + 1.2 ± 0.05 mm [0.048 ± 0.005 in.] Advance) = Thickness of Shims



INPUT ADVANCE

Figure 225 Determine Input Flange Shim Thickness

2. Position the correct thickness O.D. shims on the input shaft.

DCP5782

Figure 226 Position Input Flange Shims

3. Heat the input flange to 200°C (392°F). Push the input flange onto the input shaft until the flange contacts the shims.

⚠ WARNING

Handle the input flange with care. The input flange is HOT

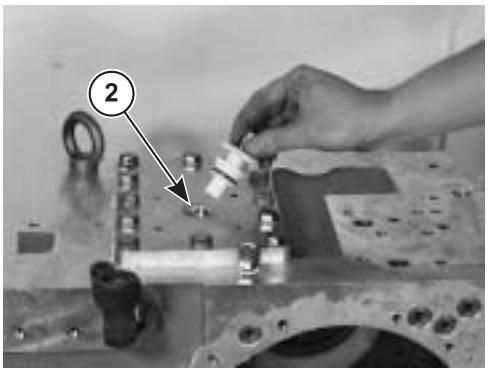
4. Position the input flange plate. Torque the screws 235 N.m (173 lb.ft).

DCP5787

Figure 227 Install Input Flange Plate

IMPORTANT

Liquid sealant must cure for a minimum of 24 hours prior to contact with oil.



AAR164R

Figure 228. Install Input Flange Plate

5. Fill the transmission with oil (2) before operation.

Installation

General Alignment Information

Proper alignment of an engine, marine transmission, and propeller is critical, both during the initial installation and at frequent intervals during the life of the boat. It is rather common for a boat to change its form with various loads and with age. Engine and shaft alignment can also change on a boat due to varying loads and the boat's age. Alignment measurements should always be made with the vessel in the water.

The remote mounted v-drive transmission must first be aligned to the propeller shaft, and then the engine aligned to the remote mounted transmission.

Note: The transmission output flange and companion flange bolts or screws must be torqued to the proper value as identified in Description and Specifications before alignment of the engine to the marine transmission..

Propeller Shaft

Before any attempt to align the engine and gearbox to the propeller shaft, proper alignment of the propeller shaft must be determined. This includes alignment of the propeller shaft through all struts and intermediate bearings. Failure to properly align the propeller shaft may result in premature wear on bearings, vibrations, or possible damage to other components.

If the length of the shaft from the last support bearing to the gearbox is excessive or a flexible stuffing box is used, the shaft must be centered prior to transmission to propeller shaft alignment.

Marine Transmission to Propeller Shaft Alignment

⚠ CAUTION

When mounting the transmission in the boat, all of the mounting pads on the transmission must be used. Failure to do so may result in damage to the transmission.

It is important to align the engine and transmission only when the boat is afloat, and NOT in dry-dock. During this alignment period, it is also advisable to fill the fuel tanks and load the boat in the typical manner that it is to be used. Some boats are built with flexibility and may change shape as the loading varies.

When a heavy boat is dry-docked, it naturally undergoes some bending. Therefore, it is always good practice to unbolt the marine transmission output coupling to prevent bending of the shaft.

Two reamed dowel pin holes are located on each of the transmission side mounting surfaces. It is required that the mounting brackets be dowelled to the transmission to maintain proper alignment, and to prevent movement of the mounting bolts in their clearance holes due to the propeller thrust.

With the transmission in position on the mounting bed, arrangements must be made to have a controlled lifting or lowering of each of the four corners of the transmission. If threaded holes are provided in each of the transmission mounts, jacking screws can be used in them. The transmission position can be adjusted with the jacking screws to obtain the desired alignment.

Steel plates must be inserted under the jacking screws so that the bolts will not damage the mounting bed. Lifting can also be accomplished by the use of chain hoists or properly placed jacks. Adjustable shims also are available and can simplify the alignment process, particularly for future realignment.

It may also be necessary to move the transmission to one side or the other on the mounting bed to obtain horizontal alignment. This can be done with a jack placed horizontally between the transmission and the foundation. At the same time, a straight edge is laid across the edges of the flanges at the top and side to check the parallel alignment of the coupling edges.

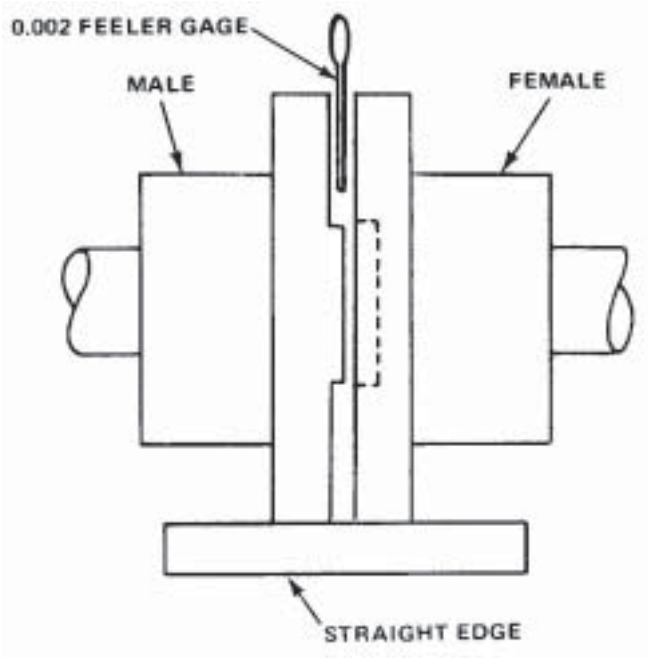


Figure 229. Checking Parallel Alignment of the Coupling

As the marine transmission come into its aligned position, it will be possible to mate the output flange and propeller coupling, and prepare for bolting together. Care should be taken not to burr or mar this connection because the fit is very critical. Place a 0.05 mm (0.002 in) feeler gauge between the flanges of the coupling. Move (slide) the feeler gauge completely around the coupling. Rotate the marine transmission flange coupling in 90 degree increments, and move the feeler gauge around the flange in each successive position. The feeler gauge will fit snugly, with the same tension, all around the flange coupling in all four positions if the alignment is correct.

If the alignment varies during rotation, additional alignment is necessary, or the marine transmission and shaft couplings should be checked for proper face runout. Runout must not exceed 0.10 mm (0.004 in). Excessive face runout on the marine transmission output flange can usually be corrected by repositioning the coupling on its spline or taper. Excessive shaft coupling runout is usually due to inaccuracy of the taper fit or key to keyway interference. The optimum relative mating location will be where the measured runout dimensions of the transmission flange and the shaft coupling flange compliment each other to result in the least relative out of true parallel measurement.

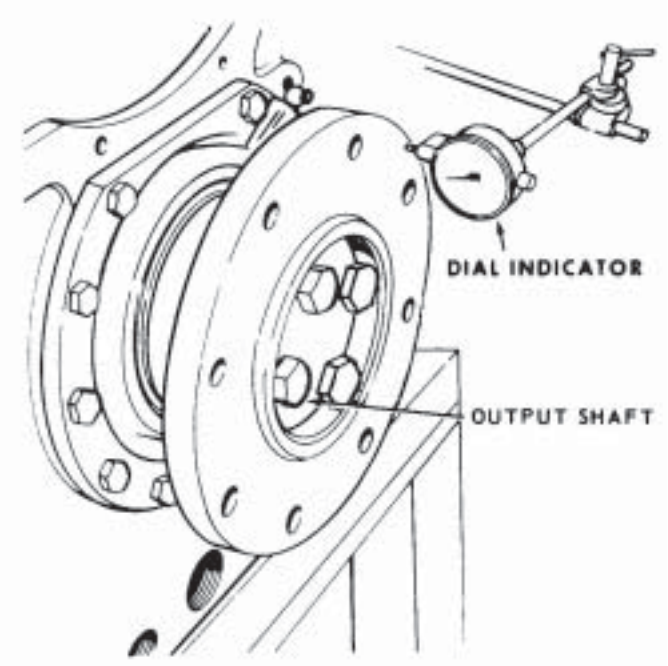


Figure 230. Checking Output Flange Face Runout

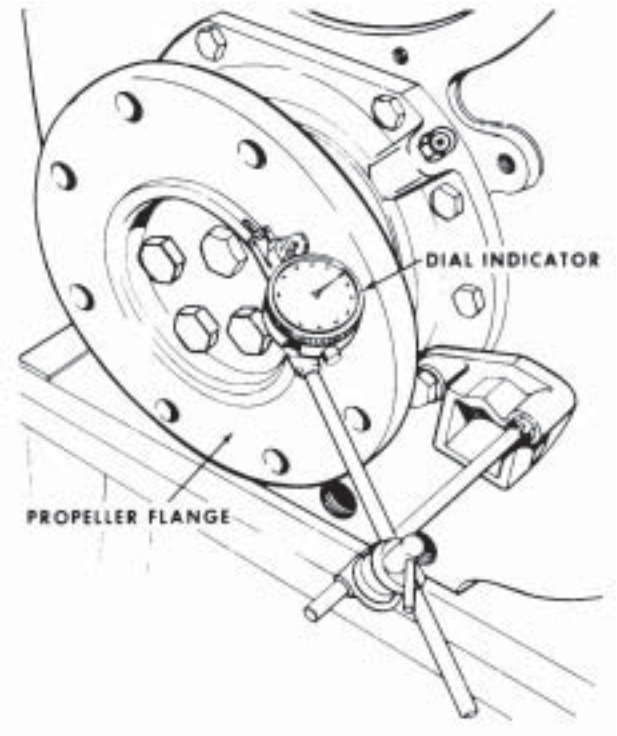


Figure 231. Checking Output Flange Pilot Eccentricity

Some boats are not structurally rigid and some carry their load in such a way that they will “hog” or go out of normal shape with every loading and unloading. Where this condition exists, it important to apply common sense alignment techniques to minimize the potential damage to any of the components.

During the process of securing final alignment, it may be necessary to shift the transmission many times. When the final alignment is accomplished, mark and drill the holes for the lag studs or locating dowel pins. Then with final alignment secured, make up the necessary poured, steel, or hardwood shims, and fasten the transmission in place. Then recheck the alignment, and if satisfactory, bolt the coupling together. See Description and Specifications for proper bolt torque.

There are many types of flexible output shaft couplings in the market today that solve a variety of problems:

- ❑ Couplings to reduce noise and vibration.
- ❑ Couplings to allow a permanent angular misalignment.
- ❑ Couplings that allow engines to be flexibly mounted and take out the momentary misalignment.

In some cases, the proper alignment of these couplings requires an accuracy equal to that of rigid couplings. Always use the alignment procedures recommended by the coupling manufacturer.

Engine Preparation

⚠ CAUTION

Most Twin Disc products mount directly onto the flywheel of the engine, or are attached to the flywheel through external shafting or adapters. Flywheel-to-driven component interference is possible due to mismatch of components or other reasons. Therefore, engine crankshaft endplay as well as flywheel alignment checks must be made before the driven component is installed.

After installation of the driven component, the crankshaft endplay should be measured again. The endplay at the second measurement should be the same as the first. A difference in these two endplay measurements could be an indication of interference. Consequently, the driven component should be removed and the source of interference found and corrected.

Twin Disc will not be responsible for system damage caused by engine to Twin Disc component interference regardless of the cause of interference. This engine crankshaft endplay check is considered mandatory.

The transmission housing flange and pilot, the engine flywheel and the flywheel housing must be checked for trueness. Clean the engine flywheel and flywheel housing mounting surfaces thoroughly before any measurements are made.

Note: To isolate engine vibration and prevent transferring it to the hull through the propeller shaft, the distance from the marine gear output flange to a fixed stuffing box or the first fixed bearing must be a minimum of 20 times the shaft diameter. If the distance is less than this, a flexible coupling may be necessary to isolate the engine vibration.

Torsional Input Coupling Alignment - Free Standing Units

Alignment of freestanding transmissions must begin by aligning the transmission output flange to the propeller shaft. The engine must then be moved to properly align the engine flywheel mounted coupling flange to the transmission input hub.

Engine Flywheel Measurements (also reference SAE J-1033 and J-617)

Note: Since the remotely mounted v-drive transmission is not attached directly to the engine flywheel housing, common sense should be used regarding any measurements taken during these procedures. The detailed instructions are included here because any engine installation should include these measurements. The flywheel runout dimensions are important to the life of any torsionally resilient coupling that may be mounted to it.

1. Bolt a thousandths increment dial indicator or gauge to the engine flywheel so that the indicator is perpendicular to the face of the engine flywheel housing, and the indicator stem is riding on the face of the flange.

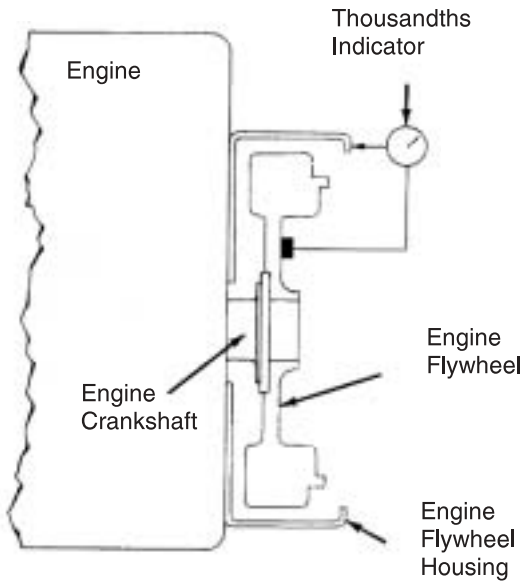


Figure 232. Checking Flywheel Housing Flange for Deviations

2. Rotate the engine flywheel, always keeping a thrust in the same direction, and note the face deviation of the engine flywheel-housing flange. The face deviation must not exceed the figures given in Table 15.

Table 12. Total Indicator Readings for Engine Flywheel Housing Flange

SAE Housing Number	Face Deviations and Bore Eccentricity mm (in)
00	0.48 (0.019)
0	0.41 (0.016)
1/2	0.36 (0.014)
1	0.30 (0.012)
2	0.28 (0.011)
3	0.25 (0.010)
4	0.23 (0.009)
5	0.20 (0.008)
6	0.18 (0.007)

3. With the indicator mounted as in the previous paragraph, adjust the indicator stem so that it will ride on the bore of the engine flywheel housing.

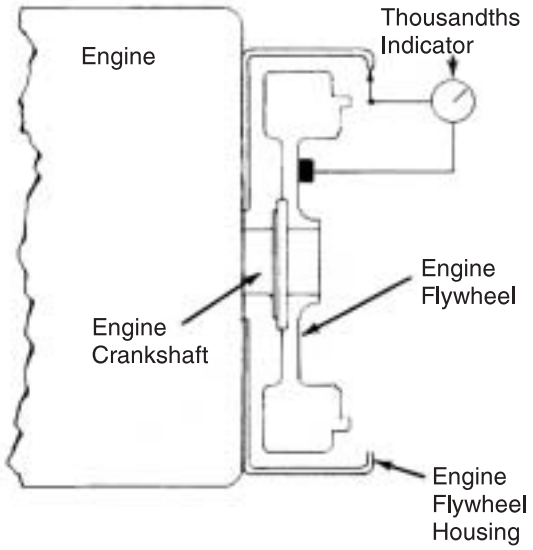


Figure 233. Checking Flywheel Housing Bore Eccentricity

4. Rotate the engine flywheel and note the bore eccentricity of the engine flywheel-housing bore. See the previous Table for allowable tolerances.

5. Bolt a thousandths dial indicator or gauge to the engine flywheel housing so that the indicator is perpendicular to the engine flywheel, and the indicator tip is riding on the inner face of the flywheel. Rotate the flywheel. The variation of the face runout of the surface to which the driving ring is bolted should not exceed 0.013 mm (0.0005 in) per inch of diameter.

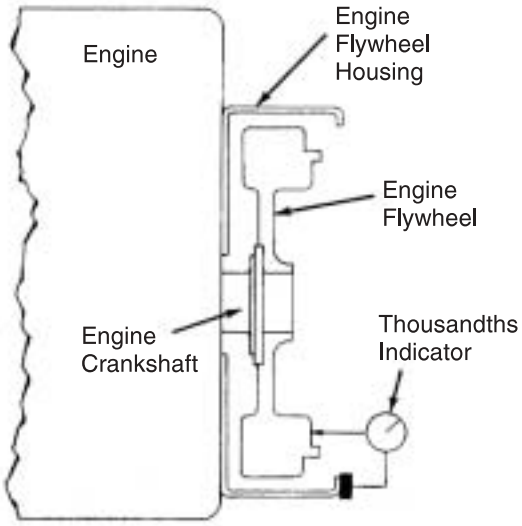


Figure 234. Checking the Flywheel Face Runout

6. With the indicator mounted as in the paragraph above, adjust the indicator tip so that it will ride on the driving ring pilot bore of the engine flywheel. Rotate the flywheel. The driving ring pilot bore eccentricity of the engine flywheel should not exceed 0.13 mm (0.005 in) maximum total indicator reading. Thrust on the flywheel should be in one direction at all times to obtain a correct reading.

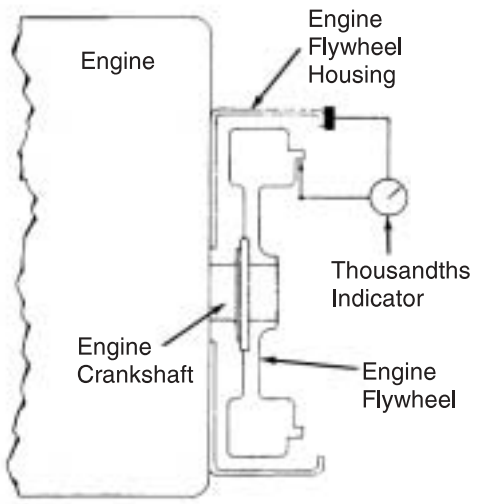


Figure 235. Checking the Flywheel Pilot Ring Bore Eccentricity

Engine to Marine Transmission Alignment

⚠ CAUTION

When mounting the engine and transmission in the boat, all of the mounting pads on both the engine and transmission must be used. Failure to do so may result in damage or excessive noise and vibration.

The transmission must be aligned to the propeller shaft, and mounted in its final location prior to the alignment of the engine and driveline to the transmission.

The engine can be mounted in the vessel such that the engine crankshaft centerline is parallel to the transmission input centerline, or with proper placement for equal u-joint angles, in a position where the located in a position that the engine crankshaft centerline is not parallel to the transmission input centerline.

The angular offset between the transmission input shaft and the driveshaft must not exceed the driveline manufacturer's recommendation. Typically the maximum allowable angle is seven (7) degrees, and the angle between the transmission input shaft and the driveline must be within one-half (0.5) degrees of the angle between the engine crankshaft centerline and the driveline.

A method of alignment is listed here to aid in proper alignment or checking an existing installation for proper alignment. The marine transmission input shaft centerline will be fixed as it is located by, and bolted to, the propeller shaft. The engine must be adjusted so that the angle between the engine crankshaft centerline and the transmission input shaft centerline are equal, and the offset angle is within the proper limits.

1. Fabricate pointer plates that can be mounted to the same transmission input flange adapter that the driveline will connect to, and to the engine flywheel mounted coupling that the driveline will connect to.

2. Fabricate inner hollow tubes and outer hollow tubes, and weld pointers (indicator ends) onto inner shafts.

3. Drill a hole in same length outer tube and then weld a nut to the tube. This will be used as the retention device for the inner tube once the inner tube is slid into the outer tube.

4. Weld the tube assemblies to the plates, making sure that the tube to plate runout is zero. This will allow for adjustment of both shafts to identical lengths. Make sure there is a tight fit between the outer tube and inner tube (the closer the fit the more accurate the alignment will be).

5. Bolt one pointer onto the transmission input shaft flange. Bolt the other pointer onto the engine flywheel mounted coupling output flange. These pointers are an extension of the shaft centerlines on which they are mounted. If the installation requires that the transmission input shaft centerline is not parallel to the engine crankshaft centerline, adjust both pointers to the same lengths so the pointed end (indicator reference end) of the inner shafts are in close proximity to each other. Once this is completed use a dial indicator making sure that the run out on the pointers are no greater then .0625 inch (1.59mm). It will be necessary to check runout on both shafts by turning them each 360°. The engine position must be adjusted so that the pointer ends meet each other.

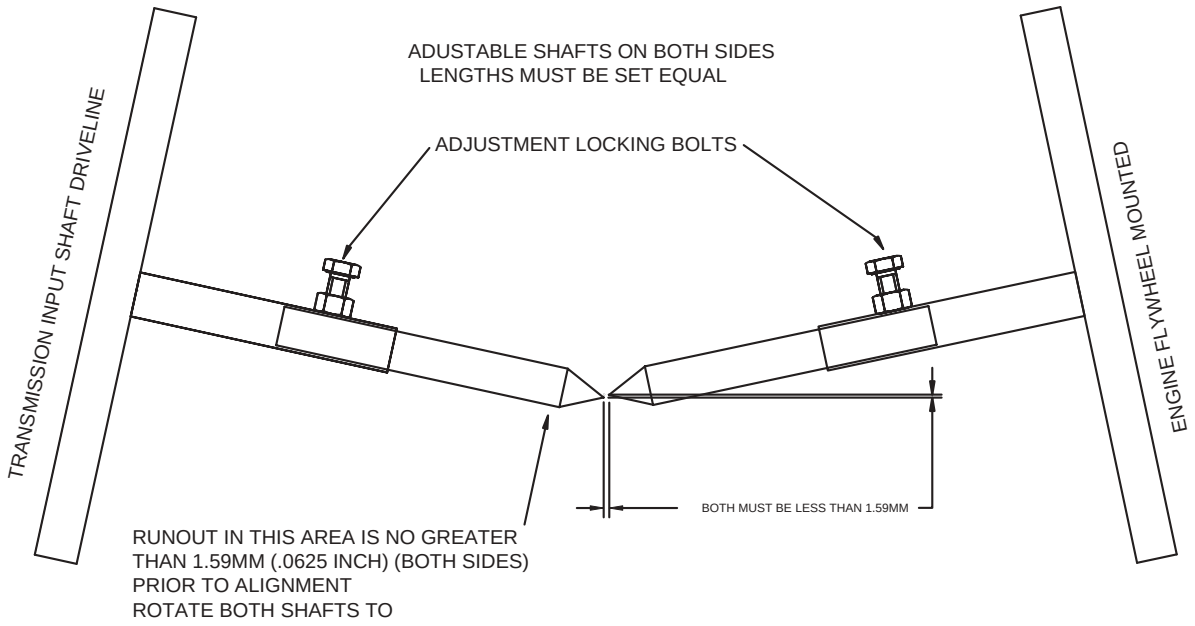

ADUSTABLE SHAFTS ON BOTH SIDES
LENGTHS MUST BE SET EQUAL
ADJUSTMENT LOCKING BOLTS
TRANSMISSION INPUT SHAFT DRIVELINE
ENGINE FLYWHEEL MOUNTED
BOTH MUST BE LESS THAN 1.59MM
RUNOUT IN THIS AREA IS NO GREATER
THAN 1.59MM (.0625 INCH) (BOTH SIDES)
PRIOR TO ALIGNMENT
ROTATE BOTH SHAFTS TO

Figure 236. Remote or Island Mounted Alignment Tool, Shafts not Parallel

6. If the engine position can be adjusted so that the transmission input shaft centerline will be parallel to the engine crankshaft centerline, the engine must be adjusted so that the two rods are parallel to each other. The rods can be lengthened as long as the runout is within the allowable limits to ease in the adjustments.

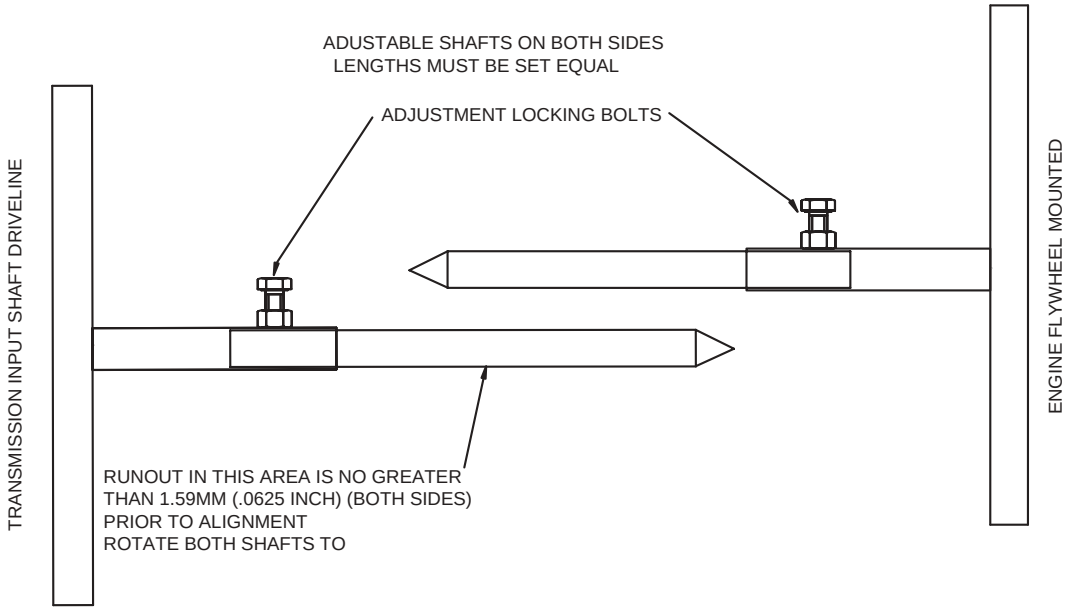

ADUSTABLE SHAFTS ON BOTH SIDES
LENGTHS MUST BE SET EQUAL
ADJUSTMENT LOCKING BOLTS
TRANSMISSION INPUT SHAFT DRIVELINE
ENGINE FLYWHEEL MOUNTED
RUNOUT IN THIS AREA IS NO GREATER
THAN 1.59MM (.0625 INCH) (BOTH SIDES)
PRIOR TO ALIGNMENT
ROTATE BOTH SHAFTS TO

Figure 237. Remote or Island Mounted Alignment Tool, Shafts Parallel

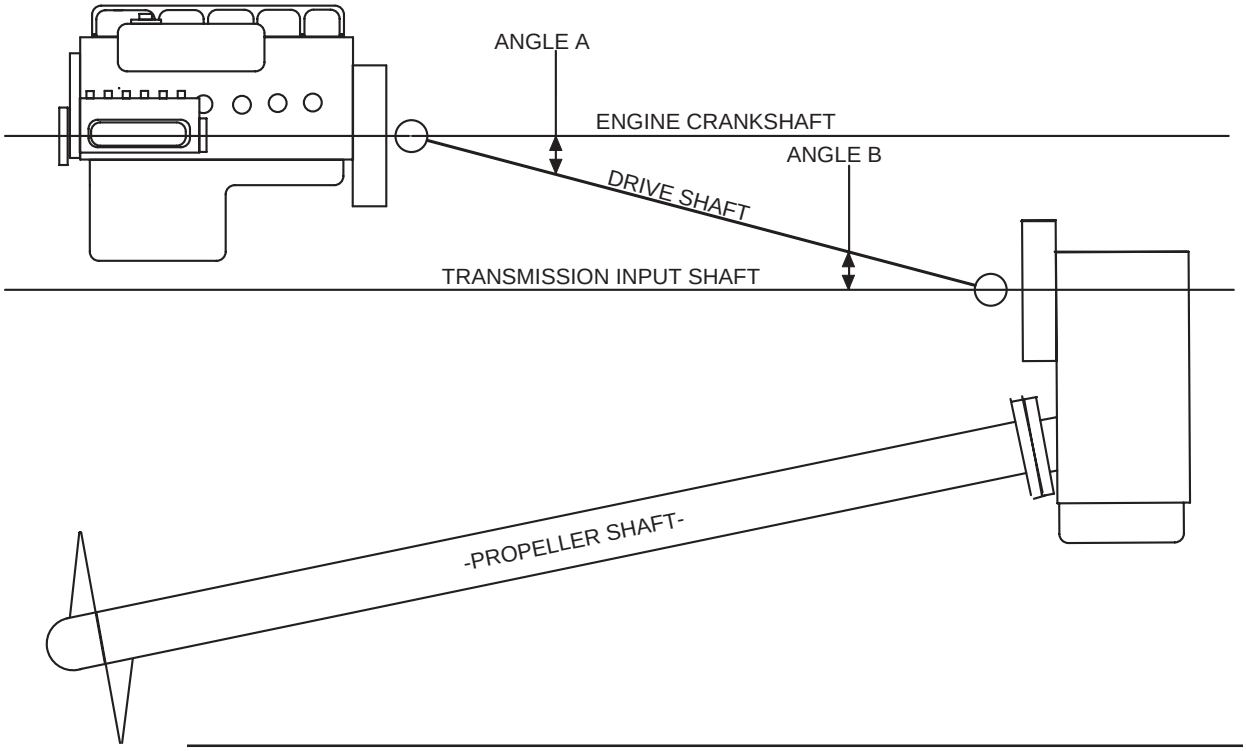


Figure 238. Engine Crankshaft Centerline Parallel to Transmission Input Shaft (Note that Angle A must equal Angle B within 1/2 degree.)

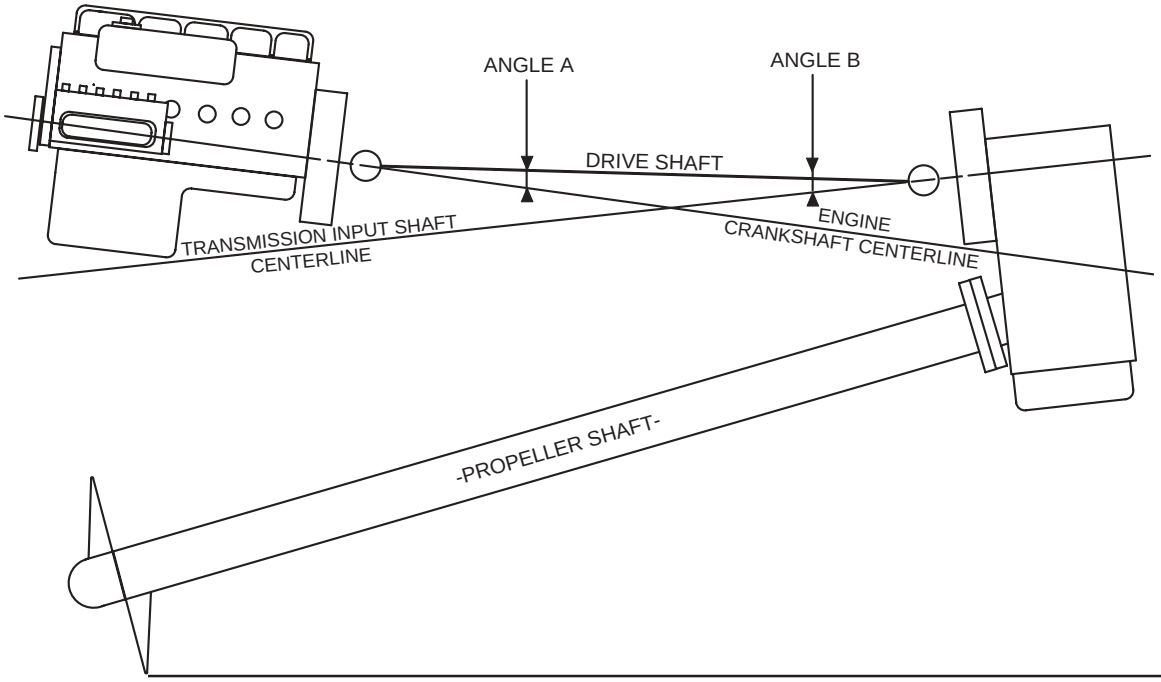
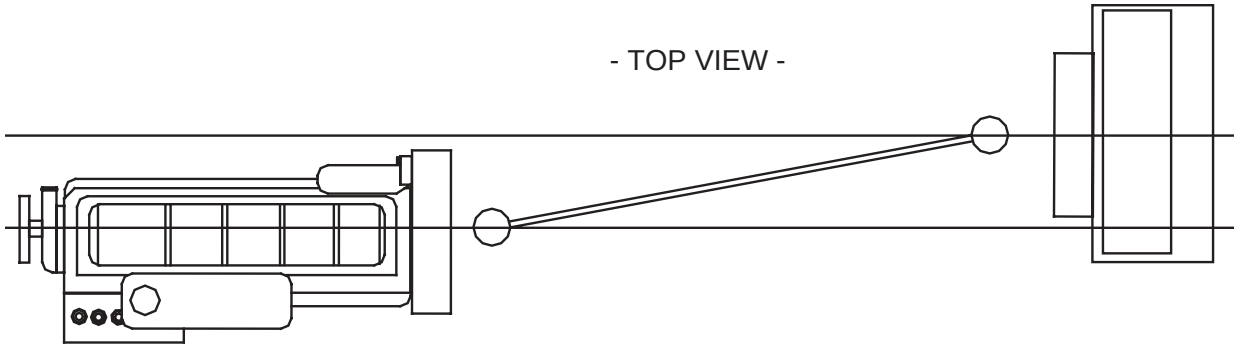
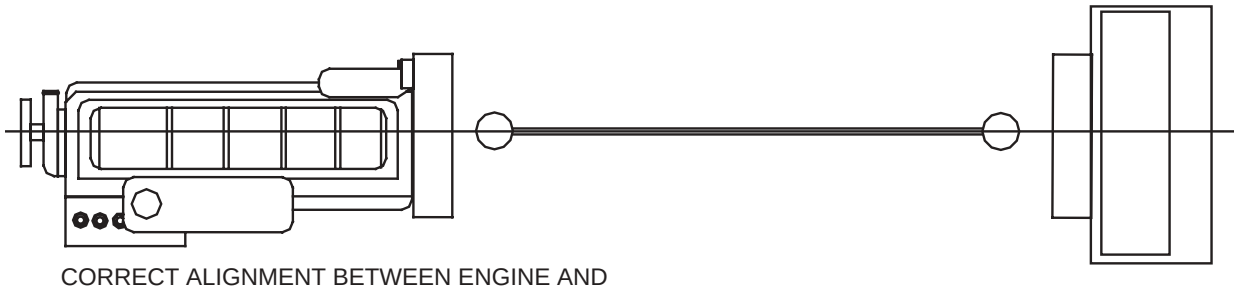


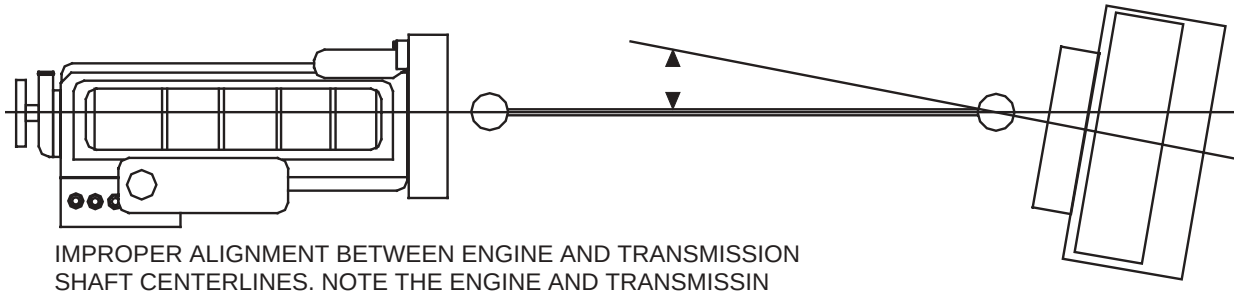
Figure 239. Engine Crankshaft Centerline Not Parallel to Transmission Input Shaft (Note that Angle A must equal Angle B within 1/2 degree.)



CORRECT ALIGNMENT USING PARALLEL PLANES BETWEEN ENGINE AND TRANSMISSION CENTERLINES. A VARIABLE-LENGTH UNIVERSAL SHAFT MUST BE USED.



CORRECT ALIGNMENT BETWEEN ENGINE AND TRANSMISSION CENTERLINES. THE ENGINE AND TRANSMISSION CENTERLINES USE THE SAME PLANE IN THIS TOP VIEW. A VARIABLE-LENGTH UNIVERSAL SHAFT MUST BE USED.



IMPROPER ALIGNMENT BETWEEN ENGINE AND TRANSMISSION SHAFT CENTERLINES. NOTE THE ENGINE AND TRANSMISSIN CENTERLINES ARE NOT ON PARALLEL PLANES.

Figure 240. Examples of Proper and Improper Installations (Top View)

With the transmission in position on the engine bed, arrangements must be made to have a controlled lifting or lowering of each of the four corners of the engine. If threaded holes are provided in each of the engine mounts, jacking screws can be used in them. The engine can be raised by screwing down, or lowered by backing off on the jacking screws to obtain the desired adjustment.

Steel plates must be inserted under the jacking screws so that the bolts will not damage the engine bed. Lifting can also be accomplished by the use of chain hoists or properly placed jacks. Adjustable shims also are available and can simplify the alignment process, particularly for future realignment.

It may also be necessary to move the engine to one side or the other on the engine bed to obtain horizontal alignment. This can be done with a jack placed horizontally between the engine and the foundation.

Driveline Installation

Both ends of a two piece driveline must be in phase with each other. Many drivelines contain a “slip spline” between the two ends, and the male and female sides of the slip spline may be capable of assembly at random angular positions. The correct orientation of the yoke arms on each end of the driveline is for them to be parallel to each other. When the two splined-together yokes or “forks” of the driveline are in the same plane (parallel to each other), the universal joints are considered to be “in-phase”. It is very important to maintain the two yoke ends “in-phase” when reassembling the driveline after service.

Transmission Controls

⚠ CAUTION

Transmission controls must be checked for proper function and alignment after any transmission selector valve is properly indexed in relation to the operator's control lever. Failure to do so could cause control system malfunction, resulting in personal injury and or damage to equipment and property.

See specific marine transmission installation drawings for detail and dimensional information needed for the proper installation of control linkages, power engaging devices, or electrical connections.

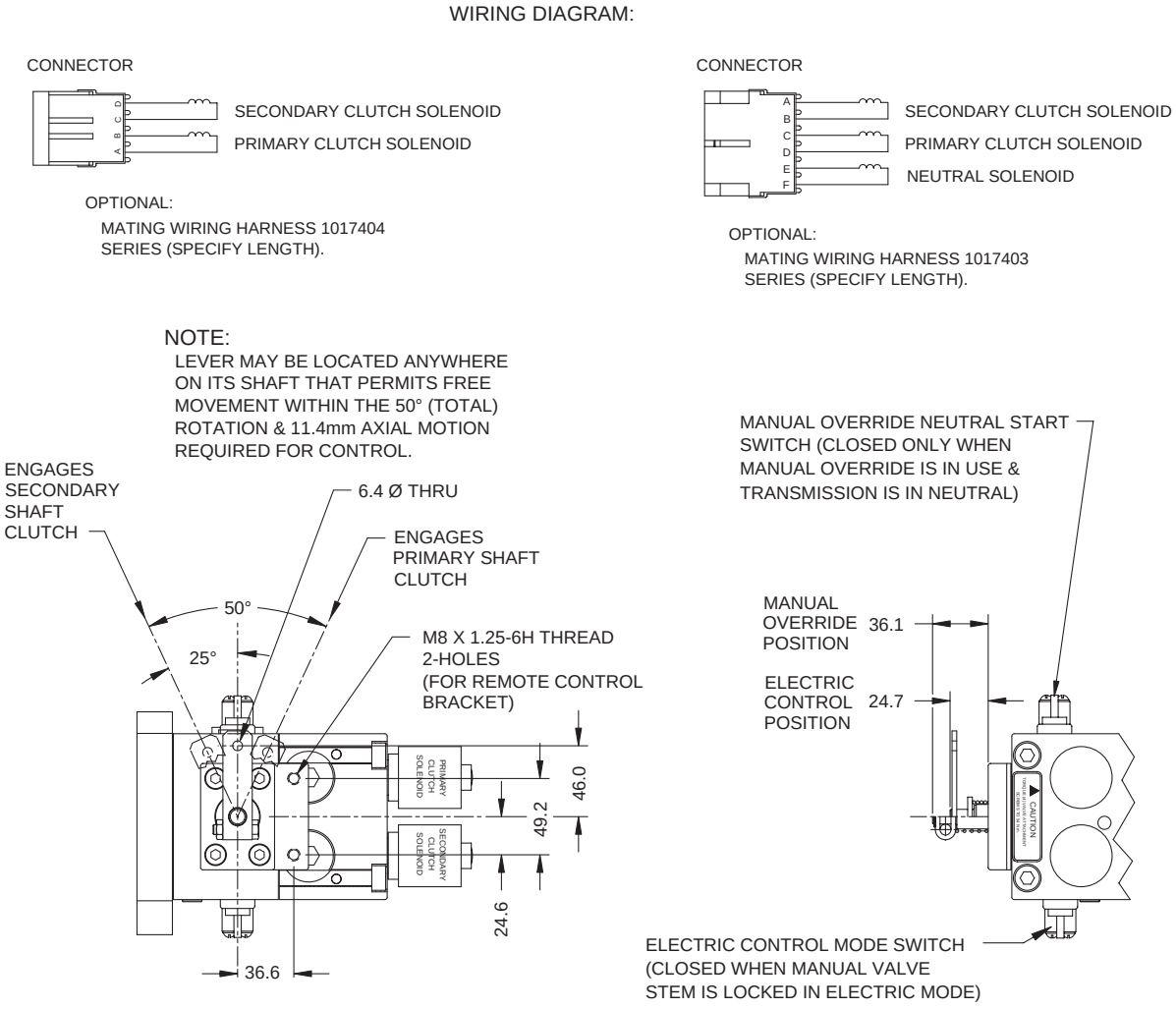


Figure 241. Electric Control Valve Installation Specifications

Mechanical Controls

If the manual override valve is connected to a control cable or device, movement of the operator's selector lever to the forward, neutral or reverse position must result in the transmission control valve selector being positioned in the forward, neutral or reverse detent location. Cables and linkages must be supported properly and not have any excessive slack that will allow relative movement between the operators selector lever and the transmission control valve selector lever.

Power Controls

Selector valve positioning devices must be installed so that full travel of the actuating cylinder places the transmission selector valve in the detent position for forward or reverse, as selected, without exerting pressure on the rotational stop on the selector valve stem. Selecting neutral must place the selector valve in the neutral detent position. Improper installation of power engaging devices could cause failure of the selector valve stop permitting improper positioning of the selector valve and resulting in control malfunction.

Electrical Controls

All electrical wires and connectors must be adequately supported to prevent rubbing, chafing, or distress from relative movement. All electrical connections must be tight and free from any corrosion.

Wiring Connections for Optional GP Control Valve

General

The vessel wiring for the Profile or E-Troll Module must be of sufficient size to prevent excessive voltage drop (no greater than 0.5 Vdc) between the battery connections (positive voltage and ground) and the Profile or E-Troll Module. The battery power connection must be protected by an electrical over-current protection component (fuse or circuit breaker) as required by the vessel's approval agency. The minimum current capacity should be 5 amps.

WARNING

Do not connect valve coils directly to battery power supply voltage. Use an approved Twin Disc Control System.

The customer supplied selector switches for each of the transmission clutches and for troll (if equipped) must be connected directly to the wires of the Profile or E-Troll Module, and connected to the power source as shown in the table that follows. No other electrical loads should be connected to this circuit.

Make the following Connections

The following power connection chart lists the possible configurations for connecting Electronic Profile or E-Troll Module to the power source for the three possible wiring options.

- ☐ Option 1 connections are used when the Profile or E-Troll Module is connected to non-electronic lever heads.
- ☐ Option 2 connections are used when the Profile or E-Troll Module is connected to electronic gear controllers.
- ☐ Option 3 connections are used when the Profile or E-Troll Module is connected to electronic control solenoid driver outputs. The electronic control's Solenoid A and B returns or negative signals should be connected together and connected to the E-Troll module return (if equipped). Electronic control solenoid drivers must have their solenoid return internally connected directly to ground. If not, the Profile or E-Troll Module must be interfaced to the electronic control with relays.

Table 13. Module Power Connection Chart

Wire	Wiring Option 1	Wiring Option 2	Wiring Option 3
Troll Enable Switch Return (if equipped)	Connect to the negative terminal of the engine battery.	Connect to the same ground point used by the gear controller or the engine control.	Connect to the same point as the control's power ground signal.
Solenoid B Switch	Connect to the positive terminal of the engine battery through the switch contacts used to energize Solenoid B.	Connecxt to the output in the gear controller that is used to energize Solenoid B.	Connect to the control's Solenoid B positive driver output.
Solenoid return	Connect to the negative terminal of the engine battery.	Connect to the same ground point used by the gear controller or the engine control.	Connect to the control's solenoid negative output circuit.
Solenoid A Switch	Connect to the positive terminal of the engine battery through the switch contacts used to energize Solenoid A.	Connect to the output in the gear controller that is used to energize Solenoid A	Connect to the control's Solenoid A positive driver output.

- ☐ The customer supplied normally closed not in neutral relay must be located in a position to not be affected by vibrations. The coil must have a 200 ma maximum current draw. The coil must be connected to the two "not in neutral" wires of the Profile Generator.
- ☐ The contacts of the manual direction control switch (closed in neutral) must be wired in series with the energizing coil of the not in neutral relay.
- ☐ Plug the appropriate connectors from the Profile Generator into the appropriate Proportional Valves and Temperature sensor..
- ☐ Plug the appropriate connectors from the Profile Generator into the Engine Speed sensor and the Propeller speed sensor (if equipped).

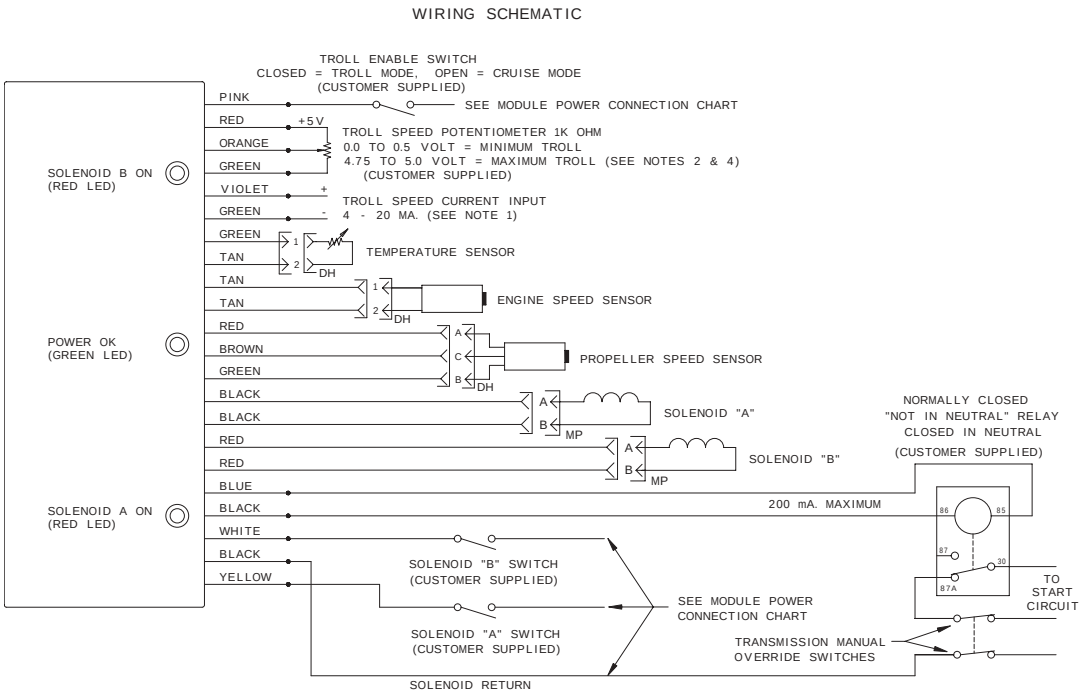


Figure 242. E-Troll Wiring Diagram

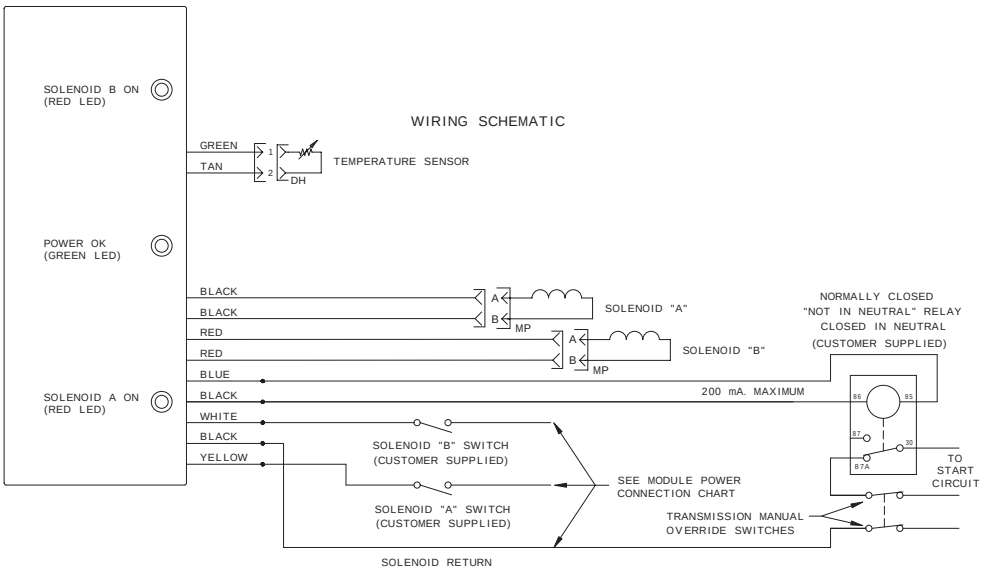


Figure 243. Profile Module Wiring Diagram

Final Checks

Be sure the transmission is filled with oil before starting. See Description and Specifications and Preventative Maintenance for proper oil and filling

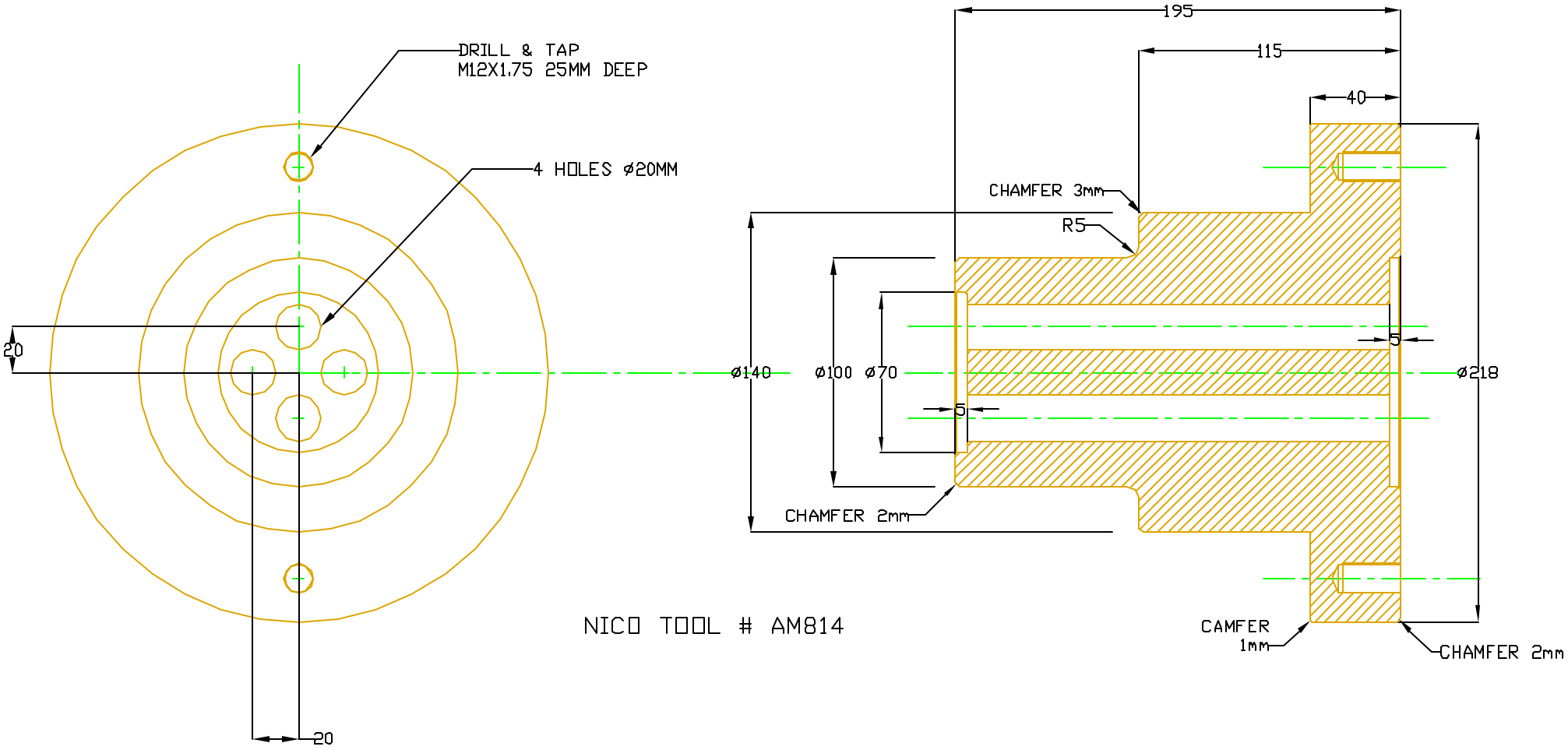
Special Tools

List of Special Tools

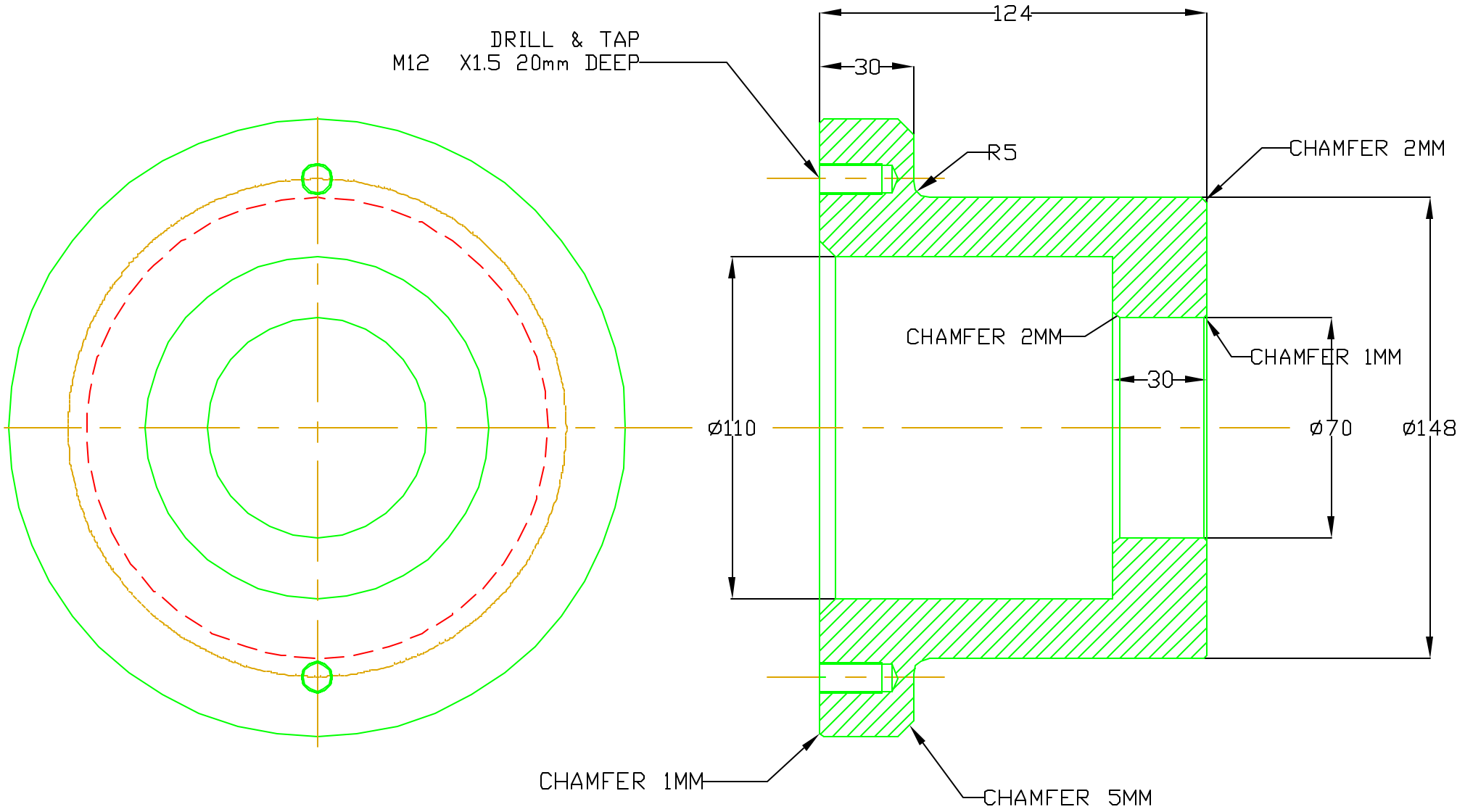
The following pages include the special tool drawings that are specific to this model. The special tool drawings included are listed below and continued on the following page.

Note: Any part numbers listed in the following engineering drawings are for reference only. Please refer to your bill of material for part numbers specific to your model.

- ❑ AM814
- ❑ AM814A
- ❑ T-21482-2 Input Seal Drive and Protection Sleeve
- ❑ T-21482-6 Retention Block and Screw
- ❑ T-21482-8 Oil Injection Adapter Tool
- ❑ T-21482-17 Output Seal Driver
- ❑ T-21482-26 Bearing Driver
- ❑ T-21482-44 Adjustable Jack
- ❑ T-21482-45 Bearing Driver

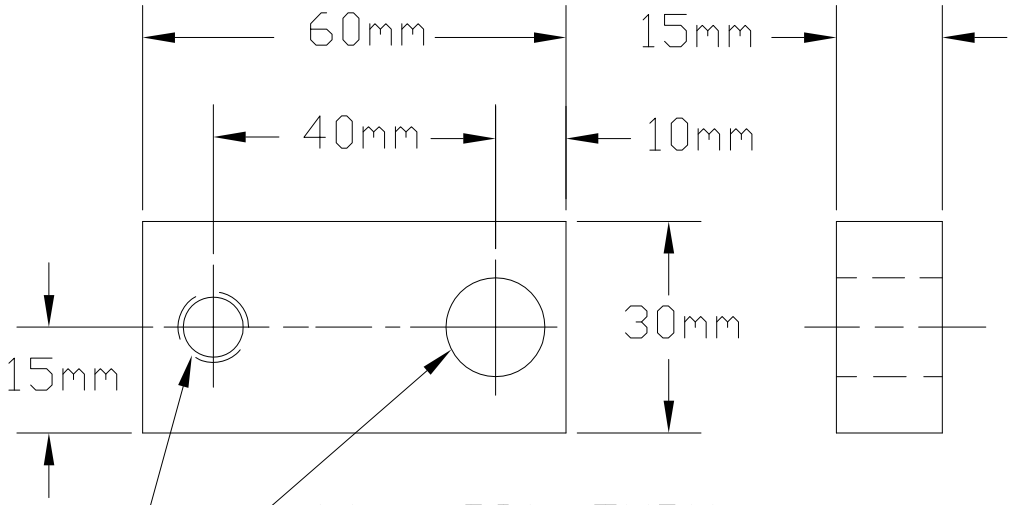


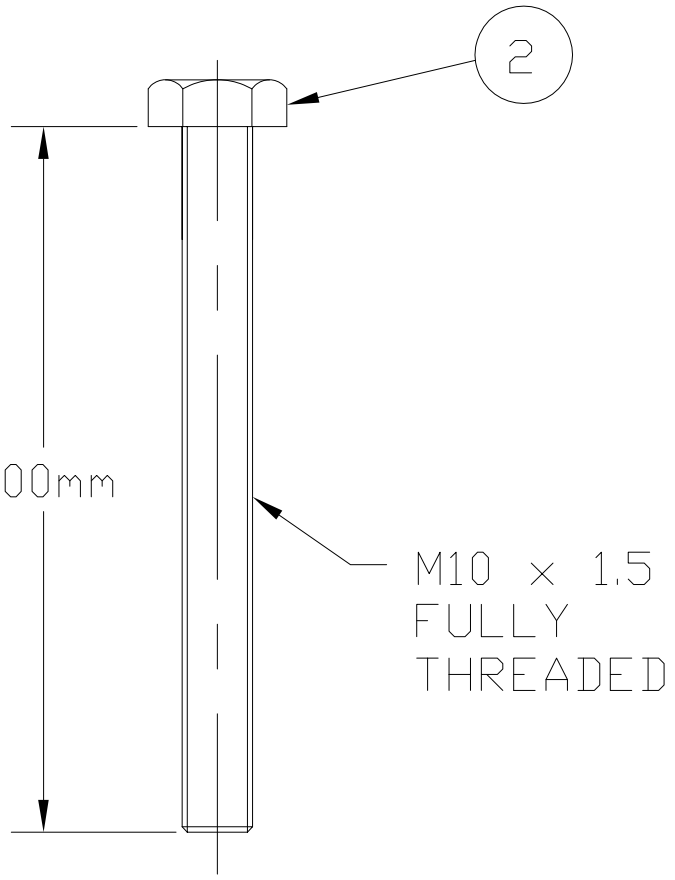
NICO TOOL # AM814



NICO TOOL # AM814A

CHG	DESCRIPTION	DATE	BY





(1) PULLER BLOCK (2) REQ'D.
MAT. : M.S.
SIZE : .62 x 1.25 x 2.50 LONG

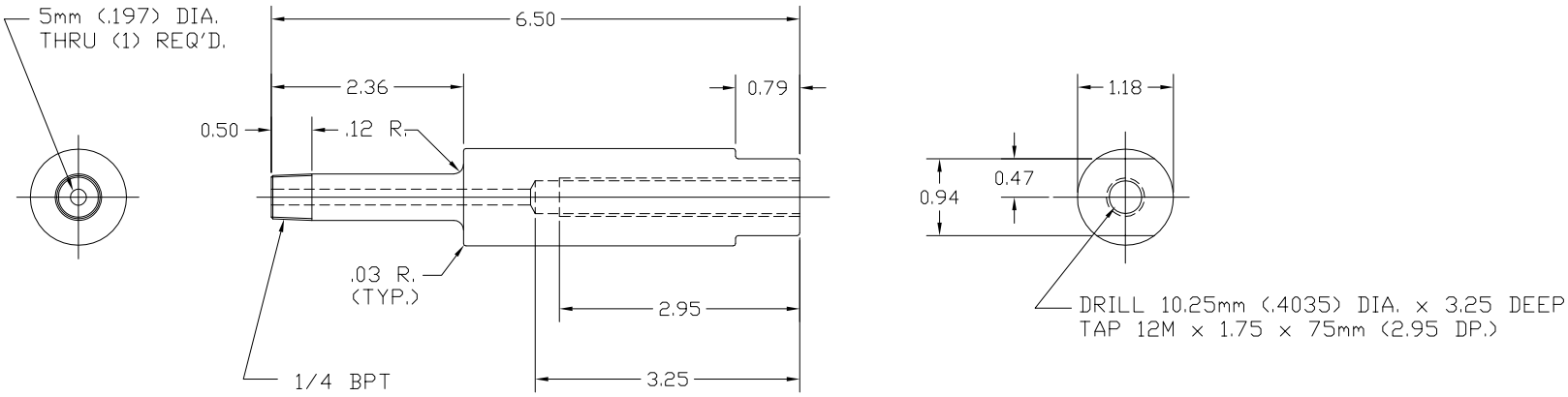
(2) NOTE : MAKE FROM HEX HEAD CAP SCR. PROPERTY GR. 8.8 (2) REQ'D. - USE ON ALL MODELS

CAD FILE : 21482-6 FOR MG 6557, MG 6619 & MG 6600 MODELS

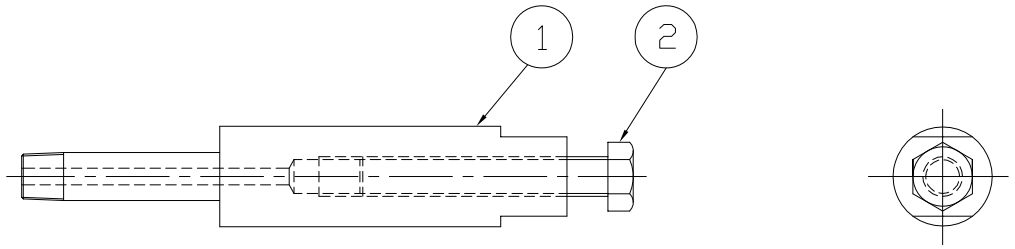
TWIN DISC, INC.	RETENTION BLOCK AND SCREW	JPL	12-13-97	PART NO: T-21482-6

576022

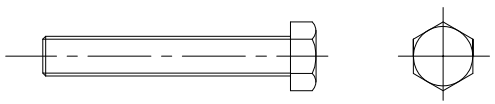
FORM 1390A



(1) HYDRAULIC KNOCK-OUT TOOL
MAT. : M.S. (1) REQ.D



HYDRAULIC KNOCK-OUT TOOL
WITH M12x1.75 FULLY THREADED BOLT



(2) M12 x 1.75 x 75mm LONG
GRADE 8.8 (1) REQ'D.
FULLY THREADED

GRADE 8.8 METRIC

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
2	1	STK.	METRIC HEX BOLT	M12x1.75 x 75mm LG.
1	1	M.S.	KNOCK-OUT TOOL	1.25 DIA. x 6.75 LG.

Date: 1-9-98 | By: JPL | F.P.N.: | Scale: FULL

NAME HYDRAULIC KNOCK-OUT TOOL

FOR MG 6557SC & MG 6557A
MG 6600 & MG 6619 SERIES

SHEET 1 OF 1

T-21482-8

TWIN DISC INC. RACINE, WIS.

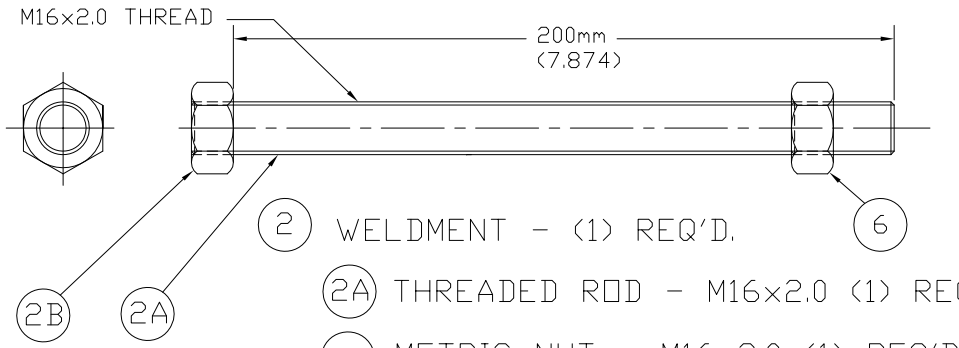
MG 6600 SERIES
MG 6619 SERIES
MG 6557 SC & MG 6557 A

STAMP TOOL NO: T-21482-8
PART NO:

BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : 21482-8

CHANGE	DESCRIPTION	DATE	BY

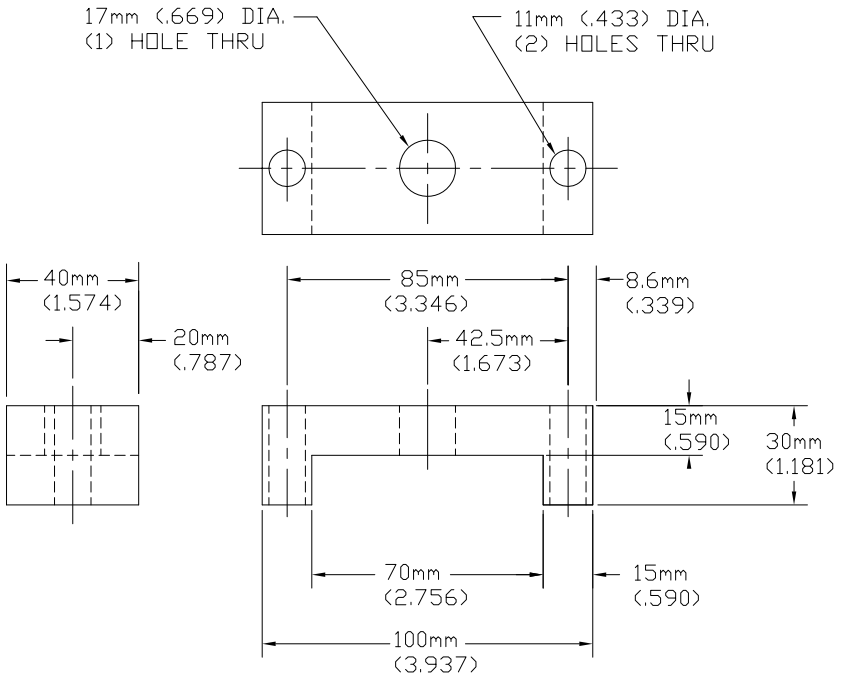


2 WELDMENT - (1) REQ'D.

2A THREADED ROD - M16x2.0 (1) REQ'D.

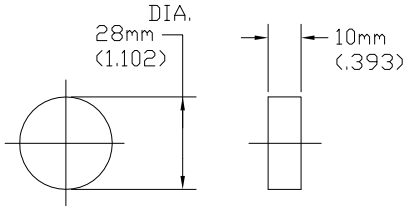
2B METRIC NUT - M16x2.0 (1) REQ'D.

NOTE : THIS WELDMENT IS THE SAME AS PART OF TOOLS : T-21482-16 & 19

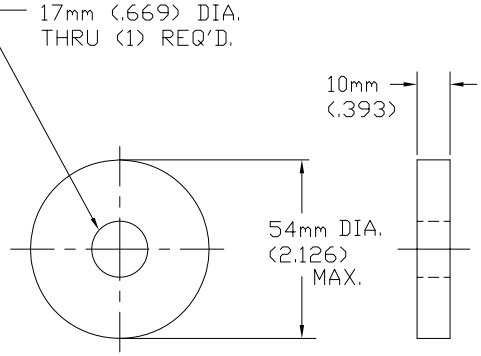


1 SUPPORT CLAMP (1) REQ'D.
MAT. : M.S.

NOTE : UNLESS OTHERWISE SPECIFIED, BREAK ALL SHARP CORNERS



3 PROTECTOR - SHAFT (1) REQ'D.
MAT. : M.S.



4 WASHER - (1) REQ'D.
MAT. : M.S.

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
6	1	STK.	METRIC NUT	M16x2.0
5	2	STK.	SOC. HD. CAP SCREW	M10x1.5 x 50mm LG.
4	1	M.S.	WASHER 2.25 DIA. x 10mm (.393) THICK	
3	1	M.S.	PROTECTOR - SHAFT	2.25 DIA. x 10mm (.393)
2B	1	STK.	METRIC THREADED ROD	M16x2.0 x 8.50 LG.
2A	1	STK.	METRIC NUT	M16x2.0
2	1		WELDMENT	
1	1	M.S.	SUPPORT CLAMP	1.25 x 1.62 x 4.00 LG

Date: 1-24-98 By: JPL F.P.N.: Scale: FULL

NAME REMOVAL TOOL FOR TRAILING PUMP GEAR SHAFT & BEARINGS

FOR MG6557 & MG6619

SHEET 1 OF 1

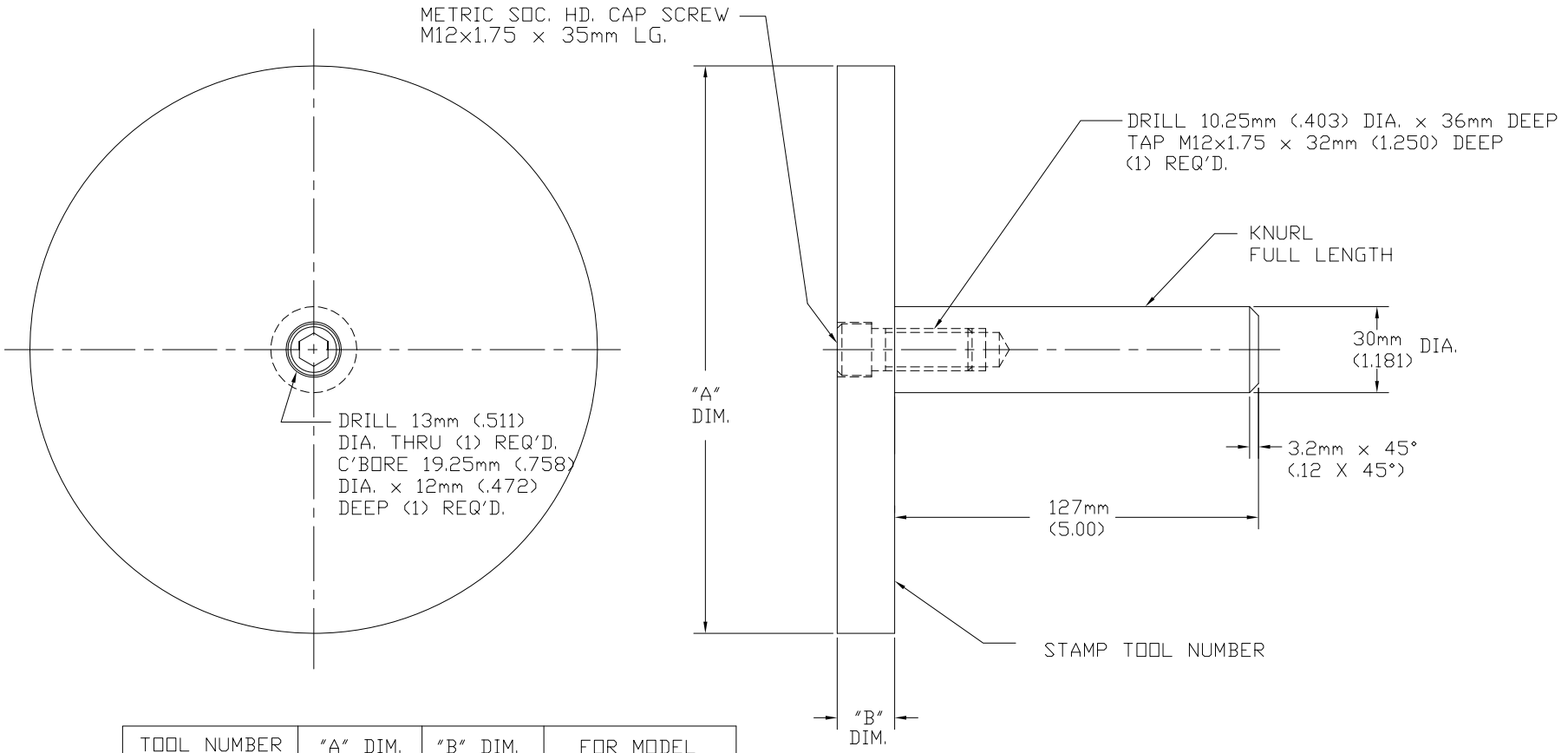
T-21482-17

TWIN DISC INC. RACINE, WIS.

CHANGE	DESCRIPTION	DATE	BY

STAMP TOOL NO: T-21482-17
PART NO: MG6557 & MG6619
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : 21482-17



TOOL NUMBER	"A" DIM.	"B" DIM.	FOR MODEL
T-21482-26	198mm	20mm	ALL MODELS
T-21482-27	178mm	20mm	ALL MODELS
T-21482-28	108mm	20mm	MG 6600 DC
T-21482-29	144mm *	20mm	MG 6557
T-21482-32	168mm	20mm	MG 6619
T-21482-33	141mm *	20mm	MG 6619
T-21482-34	188mm	20mm	MG 6619
T-21482-35	98mm	20mm	MG 6557

NOTE : MARKED WITH * CAN NOT
COMBINE THESE TOOLS

NOTE : UNLESS OTHERWISE SPECIFIED,
BREAK ALL SHARP CORNERS

3	1	STK.	SOC. HD. CAP SCR.	M16x2.0 x 45mm (1.77) LG.
2	1	D.R.	HANDLE	30mm(1.81) DIA. x 5.25 LG.
1	1	M.S.	DRIVER - BASE	(SEE CHART FOR SIZE)
DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE

Date: 4-2-98 By: JPL F.P.N.: Scale: FULL

NAME DRIVER -BEARING

FOR ALL MODELS

SHEET 1 OF

T-21482-26

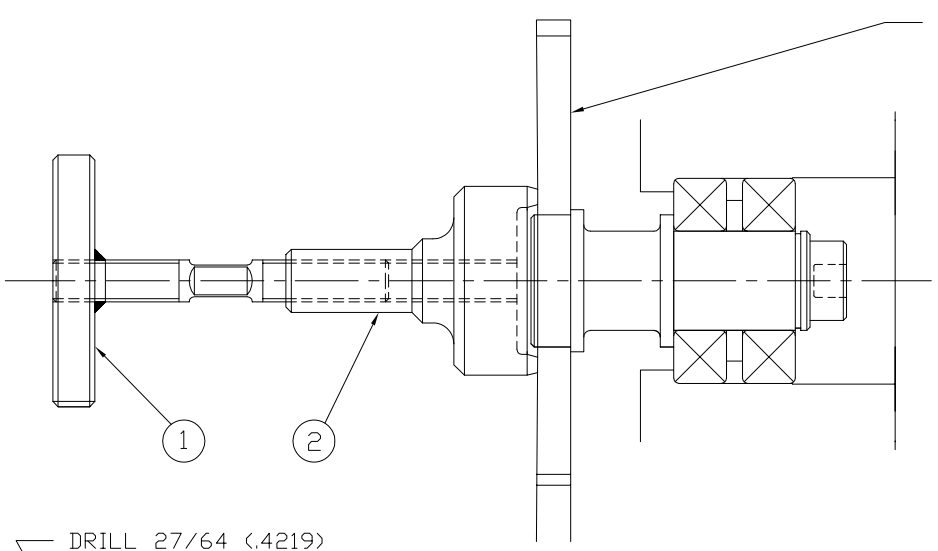
TWIN DISC INC. RACINE, WIS.

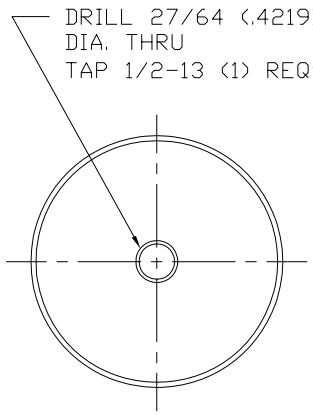
STAMP TOOL NO: T-21482-26
PART NO: ALL MODELS
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

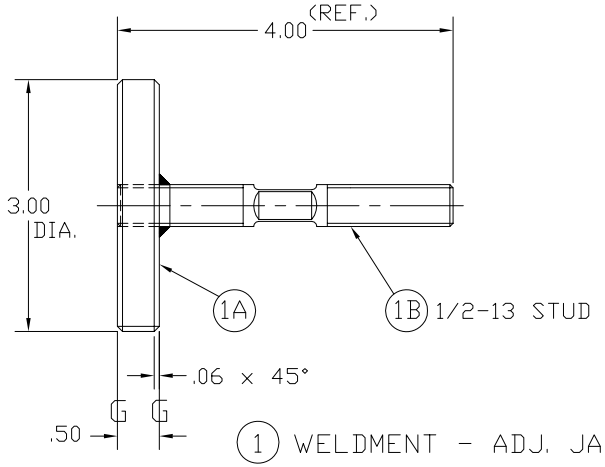
CAD FILE : 21482-26

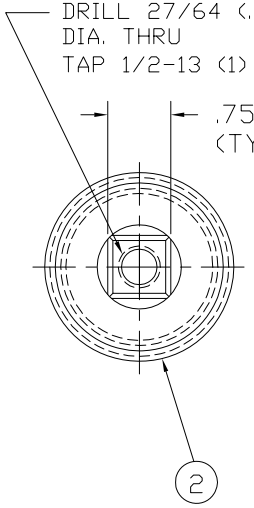
CHANGE	DESCRIPTION	DATE	BY

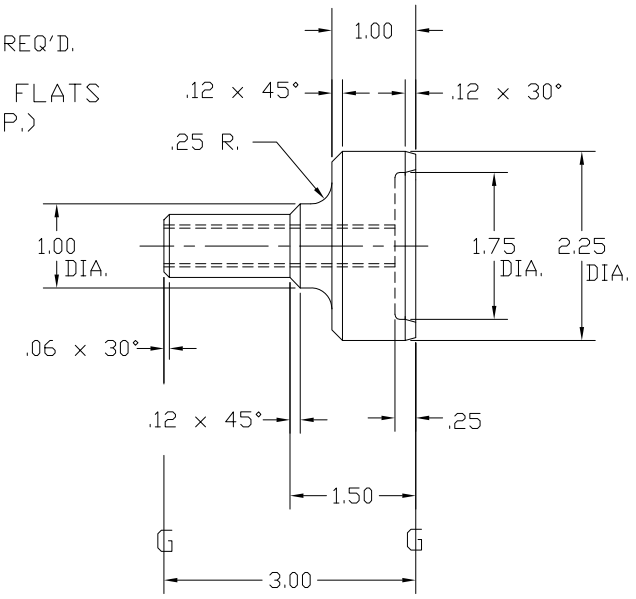
SERIES DRAWING











(1) WELDMENT - ADJ. JACK BASE (1) REQ'D.

(1A) JACK BASE (1) REQ'D.
MAT. : T.S. (CARB. & HDN.)

(1B) STUD (1) REQ'D.
1/2-13 x 4.00 LG. (PUR.)

FOR MG 6557 SC
ADJ. JACK TO HOLD
TRAILING PUMP (PT. # 3-49726)
IN PLACE WHEN PRESSING
BALL BEARINGS INTO MAIN
HOUSING

NOTE : UNLESS OTHERWISE SPECIFIED,
BREAK ALL SHARP CORNERS

NOTE : ALL GROUND (G) DIA'S. & SURFACES
TO BE SQUARE & CONCENTRIC
WITHIN .005 OF EACH OTHER

DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
2	1	T.S.	JACK BUTTON	
1B	1	PUR.	TE-CO STUD PT.# 40706	1/2-13 x 4.00 LG.
1A	1	T.S.	JACK BASE	3.00 DIA. x .50 THK.
1	1		WELDMENT - JACK BASE	

MACHINERY FACTORY

Date: 2-23-98 By: JPL F.P.N.: Scale: FULL

NAME ADJUSTABLE JACK

FOR MG 6557 SC

SHEET 1 OF 1

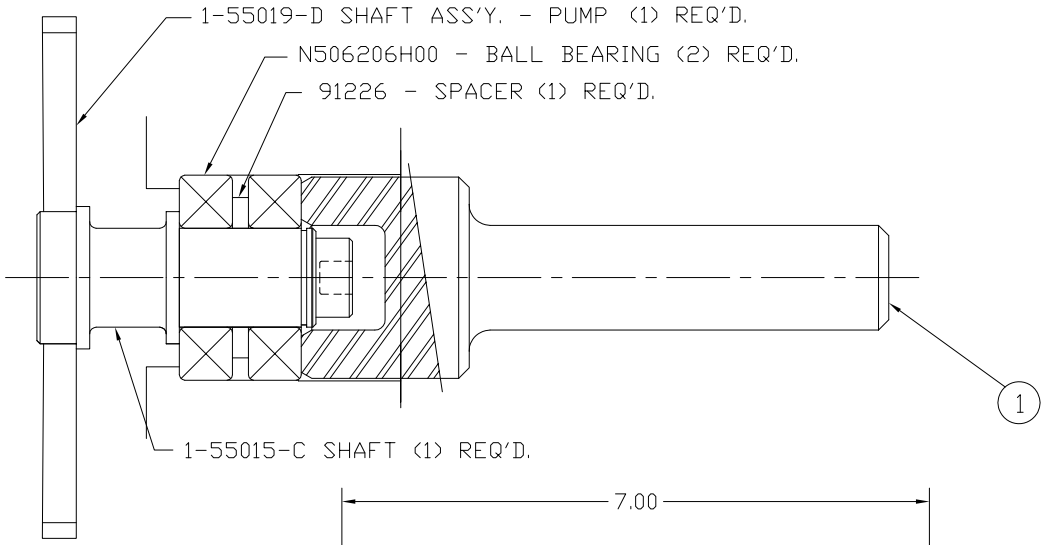
T-21482-44

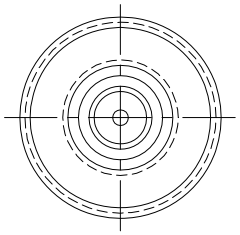
TWIN DISC INC. RACINE, WIS.

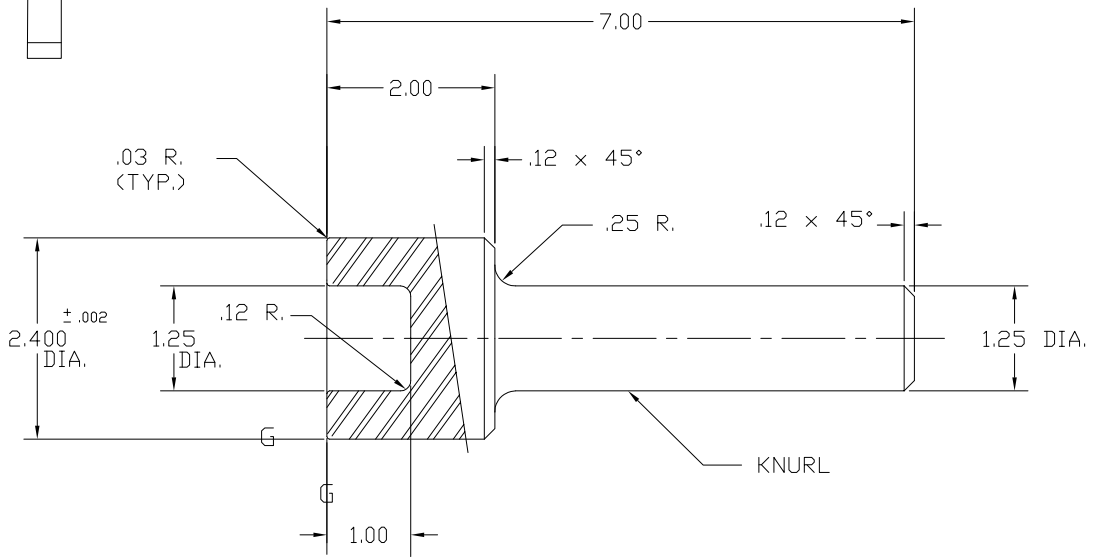
CHANGE	DESCRIPTION	DATE	BY

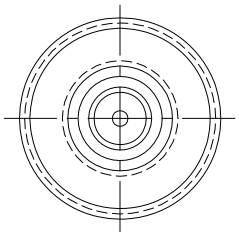
STAMP TOOL NO: T-21482-44
PART NO: MG 6557 SC
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

CAD FILE : 21482-44









FOR MG 6557 SC
INSTALL BALL BEARINGS
#N506206H00 (2) REQ'D.
WITH SPACER 91226
BETWEEN BEARINGS

NOTE : UNLESS OTHERWISE SPECIFIED,
BREAK ALL SHARP CORNERS

NOTE : ALL GROUND (G) DIA'S. & SURFACES
TO BE SQUARE & CONCENTRIC
WITHIN .005 OF EACH OTHER

(CARB. & HDN.)

1	1	T.S.	DRIVER - BEARING	2.25 DIA. x 7.25 LG.
DET.	REQ.	MAT.	DESCRIPTION	STOCK SIZE
Date: 2-23-98		By: JPL	F.P.N.:	Scale: FULL

NAME DRIVER - BEARING

FOR MG 6557 SC

SHEET 1 OF 1

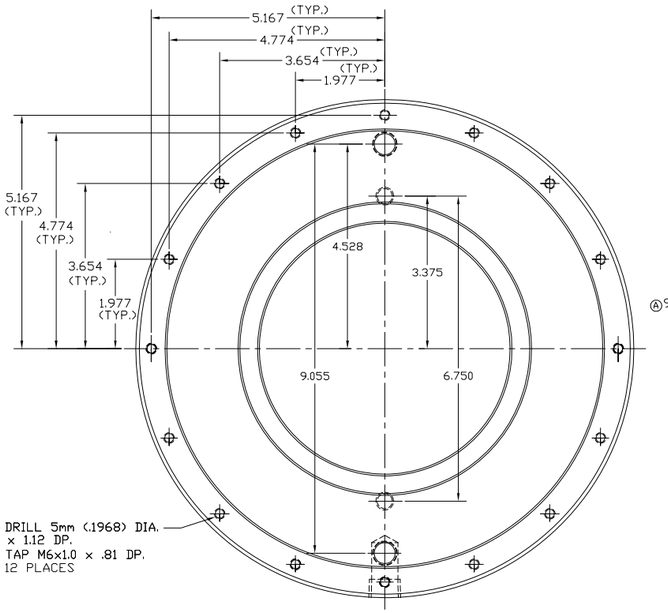
T-21482-45

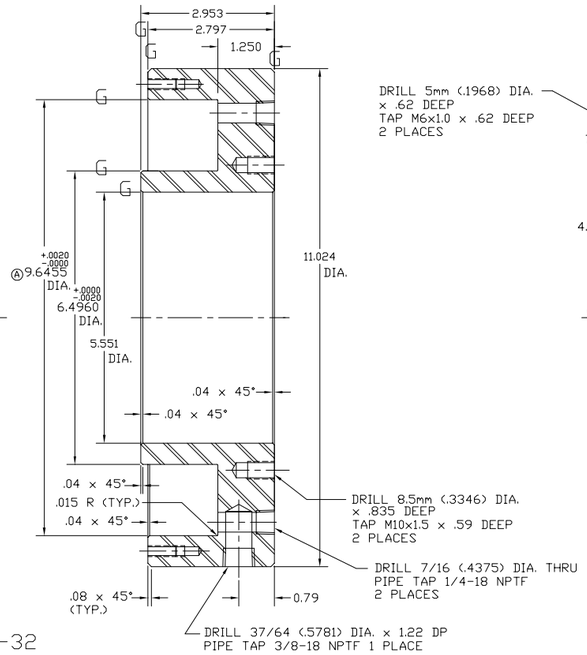
TWIN DISC INC. RACINE, WIS.

CHANGE	DESCRIPTION	DATE	BY

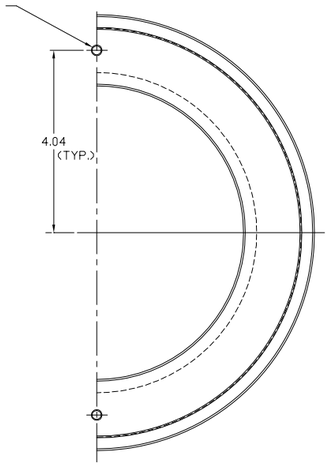
STAMP TOOL NO. T-21482-45
PART NO. MG 6557 SC
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.001 ON THREE PLACE DECIMAL DIMENSION
.010 ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
1/4 ON ANGULAR DIMENSION

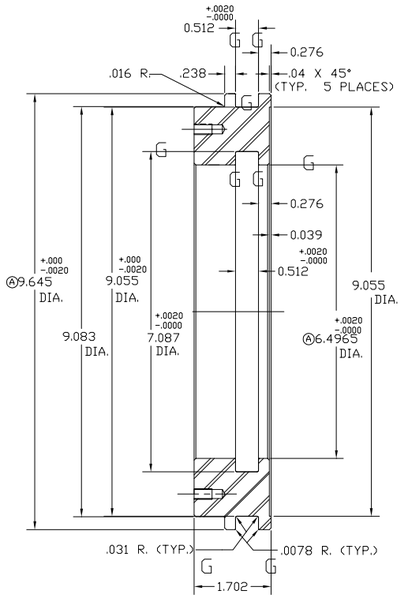
CAD FILE : 21482-45



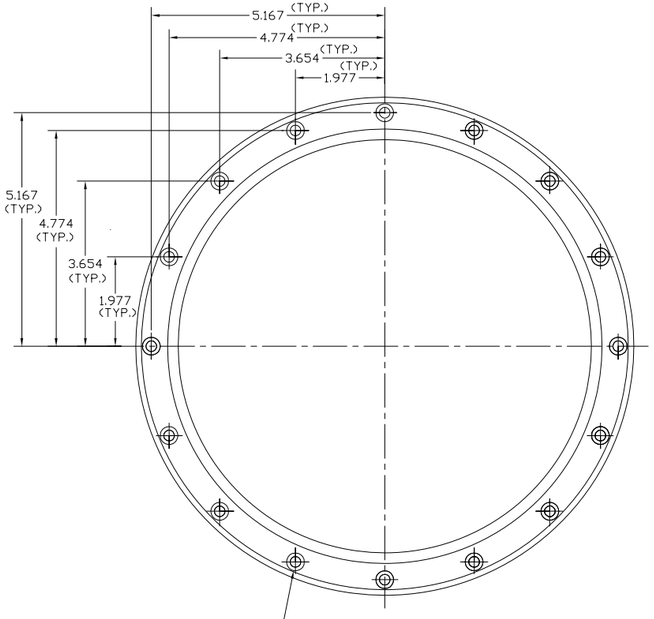


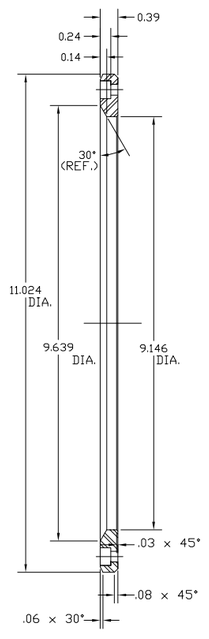
1 PISTON BODY (1) REQ'D.
Ⓐ MAT.-TS PREHARD Rc 28-32



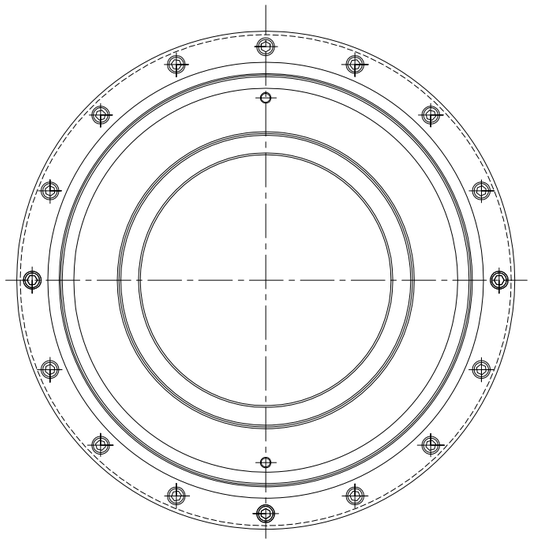


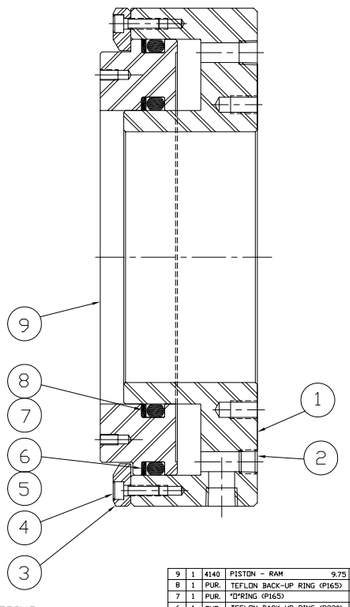
9 PISTON RING (1) REQ'D.
Ⓐ MAT.-TS PREHARD Rc 28-32





3 PISTON RETAINER (1) REQ'D.
Ⓐ MAT.-TS PREHARD Rc 28-32





Ⓐ NOTE : STAMP
"MAXIMUM OPERATING PRESSURE = 7250 PSI"
IN O.D. OF DETAIL# 1 WITH MINIMUM 1/4 INCH HIGH LETERING

NOTE : UNLESS OTHERWISE SPECIFIED,
BREAK ALL SHARP CORNERS

NOTE : ALL GRD. DIA'S. & SURFACES MUST BE
SQUARE & CONCENTRIC TO WITHIN
.001 OF EACH OTHER

9	1	4140	PISTON - RAM 9.75	DIA x 1.50 THK.
8	1	PUR.	TEFLON BACK-UP RING (P165)	
7	1	PUR.	*O'RING (P165)	
6	1	PUR.	TEFLON BACK-UP RING (P230)	
5	1	PUR.	*O'RING (P230)	
4	16	STK.	SOC. HD. CAP SCREW -METRIC	M6x1.0x20mm LG.
3	1	4140	PISTON RETAINTER 11.25	DIA. x .50 THK.
2	2	STK.	PIPE PLUG (M20SK)	1/4-18 NPTF
1	1	4140	RAM - BODY 11.25	DIA. x 3.25 THK.
DET	REQ'D	MAT.	DESCRIPTION	STOCK SIZE

Date 8-19-97 By: JPL F.P.N.: Scale: FULL

NAME RAM - GEAR TO SHAFT

FOR MG 6000

SHEET 1 OF 1

T-21482-2

REV	DESCRIPTION	DATE	BY
A	UPDATE PRINT PER ENG. REQUEST.	11-20-2000	TMV

TWIN DISC INC. RACINE, WIS.

STAMP TOOL NO: T-21482-2
PART NO: MG 6000
BREAK ALL SHARP CORNERS
TOLERANCE UNLESS OTHERWISE SPECIFIED
.XX ON THREE PLACE DECIMAL DIMENSION
.XX ON FRACTIONAL AND TWO PLACE DECIMAL DIMENSION
± ON ANGULAR DIMENSION

CAD FILE : T-21482-2.DWG

Engineering Drawings

List of Engineering Drawings

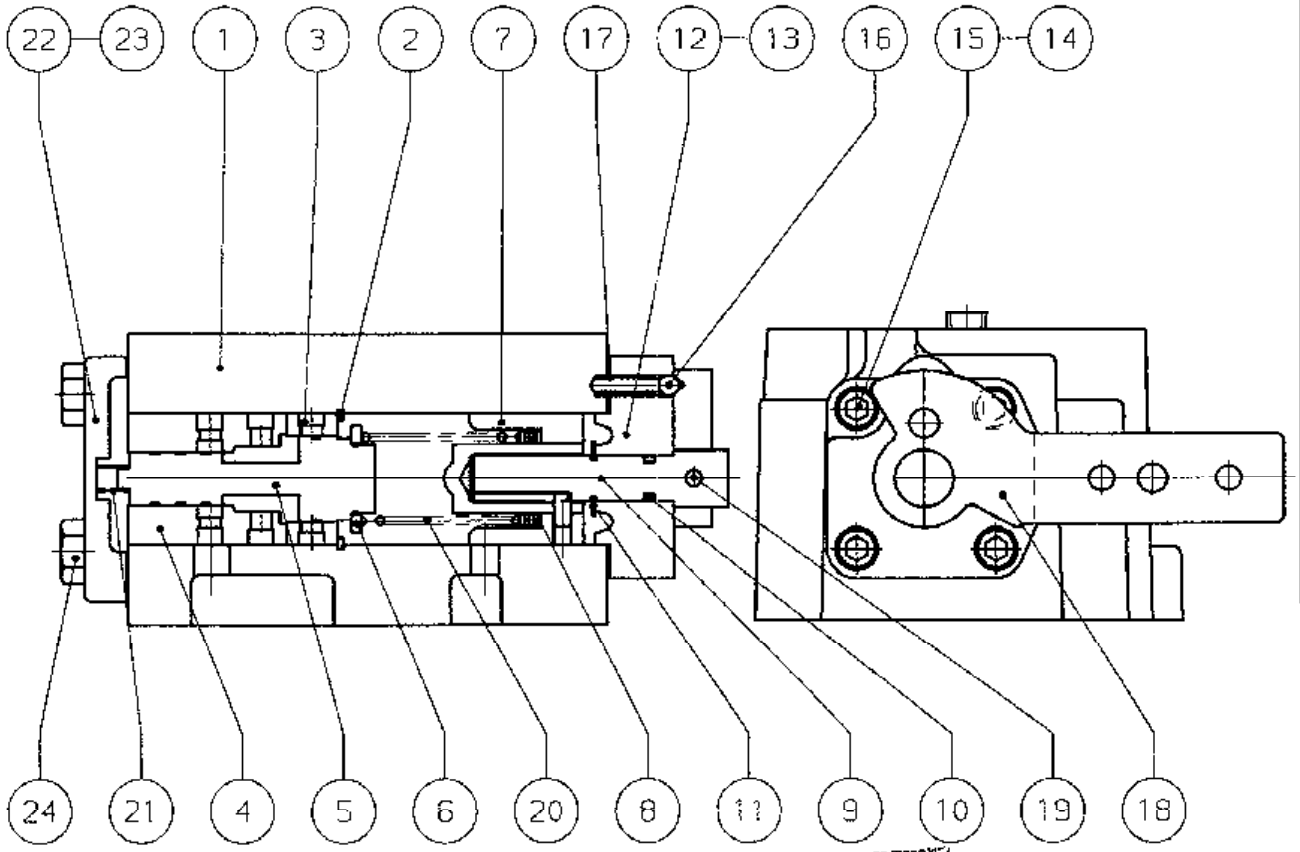
The following pages include the engineering drawings that are specific to this model. The engineering drawings included are listed below and continued on the following page.

Note: Any part numbers listed in the following engineering drawings are for reference only. Please refer to your bill of material for part numbers specific to your model.

❑	168753G	Valve Assembly, Trolling
❑	349460	Hydraulic Schematic, Transmission
❑	350178	Output Shaft Assembly
❑	549402	Pump Assembly (trailing)
❑	A7119W	Hydraulic Diagram, Electric Valve
❑	549607A	Marine Transmission, Sectional View
❑	738166	Marine Transmission, Sectional View
❑	737431B	Marine Transmission, General View
❑	738165A	Marine Transmission, General View
❑	1018084	Valve Assembly - Control (without trolling valve)
❑	737639	Live Pump Mount Power Take-off
❑	736957E	Clutchable Pump Mount Power Take-off

- ❑ 1020583 Control (E-Troll Wiring Diagram)
- ❑ 1020585 Control (Profile Module Wiring Diagram)
- ❑ 1020729 GP Valve Assembly
- ❑ 1021658 GP Valve Assembly

A4H



ITEM	PARTS NO.	N A M E	Q'TY	REMARKS
1	1-68438-A	VALVE AS	1	
2	N058003200	RING, SNAP	1	
3	1-52546	BUSH	1	
4	1-52545-E	BUSH	1	
5	1-52540-B	PISTON	1	
6	1-9241-KY	WASHER	1	
7	1-53608-E	PISTON AS.	1	
8	1-51080	SHIM	5	
9	1-50864-C	SHAFT, TROLLING VALVE	1	
10	N048002049	RING, "O"	1	
11	N083008000	RING, E TYPE SNAP	1	
12	1-12942	COVER	1	
13	1-12948-C	GASKET	1	
14	N113806030	SCREW, SOCKET HEAD	2	
15	N113806020	SCREW, SOCKET HEAD	2	
16	N131004762	BALL, STEEL	1	
17	N050005023	SPRING	1	
18	1-50863-D	HANDLE	1	
19	ND7504C020	PIN, ROLL	1	
20	K175022027	SPRING	1	
21	N175009004	SPRING	1	
22	1-54665-C	COVER	1	
23	1-61158-D	GASKET	1	
24	N085708025	SCREW, HEX.HEAD	4	

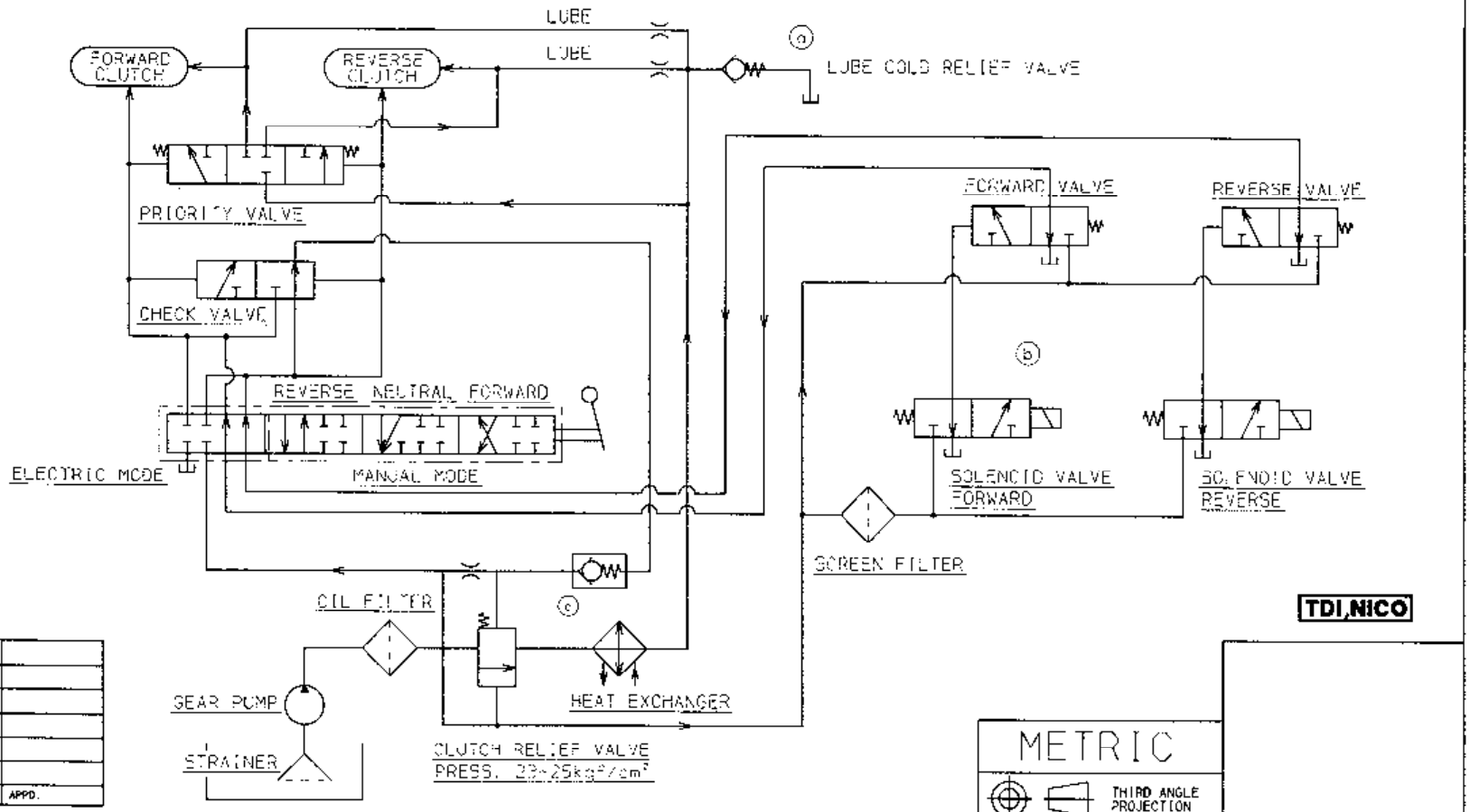
SYMBOL	DESCRIPTION	CHANGE NO.	DATE	SIGNATURE	APPROVED
		*******			
		*******			
		*******			
		*******			

REVISIONS

ISSUED
KAMO
NIIGATA CO... LTD.

APPROVED K.Ishizawa	MATERIAL -	MODEL	MG6984SC
CHECKED	HEAT TREATMENT -	NAME	VALVE, TROLLING AS.
DESIGNED K.Hayashi			
DRAWN K.HAYASHI	SCALE 1:1.5	3RD ANGLE PROJECTION	DRAWING NO. 1-68753-G
DATE 990906			

NIIGATA CONVERTER CO.,LTD.
TOKYO JAPAN



REV	BY	APPD.
c	Y.K.	
b	Y.K.	
a	K.I.	

REV	CH. NO.	DATE	REV	CH. NO.	DATE
	********			********	
	********			********	
	********			********	
c	-	2-10-98		********	
b	--	12-16-97		********	
a	---	5-26-97		********	

SIMILAR TO

-

MATERIAL

-

HEAT TREAT

-

SURFACE TREATMENT

WEIGHT XXXX kg

FIRST USE

ASSY. MODEL MG-6500-00-DC

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

NAME

HYDRAULIC DIAGRAM

DATE 97.09.18

SCALE 1:1

DRN. S.NAKAMURA

CHK.

APPD.

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

3-49460

SHEET 1 OF 1 REV ---

METRIC

THIRD ANGLE PROJECTION

TDI,NICO

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A3T

BRGシム調整

1. スイリョクジクをハウジングに組込む前に
A部のシム調整を行なうこと
隙間は 0 ~ +0.05 mm にすること

ⓑ SHIM ADJUSTMENT OF OUTPUT BEARING

1. Do adjustment A shims before gear assembling.
The clearance is 0~0.05 mm.

ⓑ ギヤ組立方法

1. テーパ部(ギヤ、スイリョクジク)は組立前に
充分な洗浄を行ない油気を取り除くこと
2. 寸法C,E,Gを測定すること
3. シム量Bを決めること
ⓐ B=E-C+(0~0.1) mm
4. ギヤにスイリョクジクを入れ、プラスチック
ハンマ等で軽く叩くこと
5. 寸法Fを測定し、押込量Dを確認すること
D=G-F

減速比	C寸法 (mm)
1.51	4.15 ~ 5.85
1.73	4.55 ~ 6.25
2.07	4.75 ~ 6.45
2.44	4.65 ~ 6.35
2.95	4.65 ~ 6.35

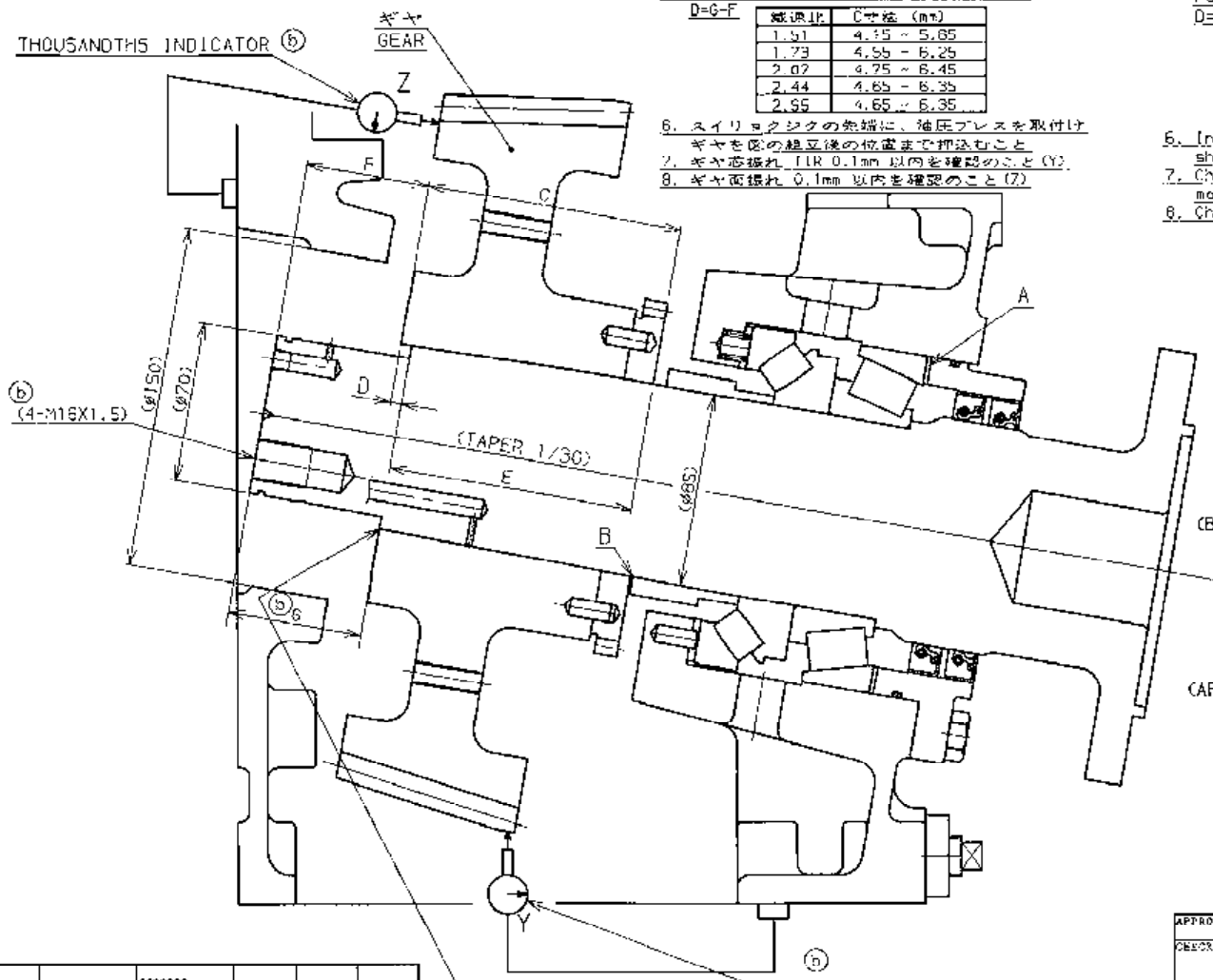
6. スイリョクジクの先端に、油圧プレスを取付け
ギヤを図の組立後の位置まで押込むこと
7. ギヤ芯振れ TIR 0.1mm 以内を確認のこと (Y)
8. ギヤ面振れ 0.1mm 以内を確認のこと (Z)

ⓑ PROCESS OF GEAR ASSEMBLING

1. Remove oil on the taper location. (Output shaft and gear)
2. Measure C,E and G.
3. Thickness of the B shims is obtained according to following formula.
B=E-C+(0~0.1) mm
4. Put the gear on the output shaft, and strike it lightly.
5. Measure F, and check advance D is within the following range.
D=G-F

GR	D D mention (mm)
1.51	4.15 ~ 5.85
1.73	4.55 ~ 6.25
2.07	4.75 ~ 6.45
2.44	4.65 ~ 6.35
2.95	4.65 ~ 6.35

6. Install an oil pressure piston at the end of the output shaft, and push in the gear to the designed position.
7. Check the output eccentricity Y should not exceed 0.1mm maximam total indicator reading.
8. Check the face deviation Z should not exceed 0.1mm.



SYMBOL	DESCRIPTION	CHANGE NO.	DATE	SIGNATURE	APPROVED
b	JAPANESE-ENGLISH WRITING	MK13045	030527	DONNATO	K.I
a	一部変更	MK10449	980626	Y. KAWANO	K. I

REVISIONS

改正記号	A
APPROVED	K. Ishizawa
CHECKED	
DRAWN	
DATE	980618
MATERIAL	-
HEAT TREATMENT	-
SCALE	1:2
3RD ANGLE PROJECTION	
MODEL	(MG6449A,RV) MGNV253
NAME	INSTALATION, GEAR ギヤ組立図
DRAWING NO.	3-50178

Hitachi Nico Transmission Co., Ltd.

A3

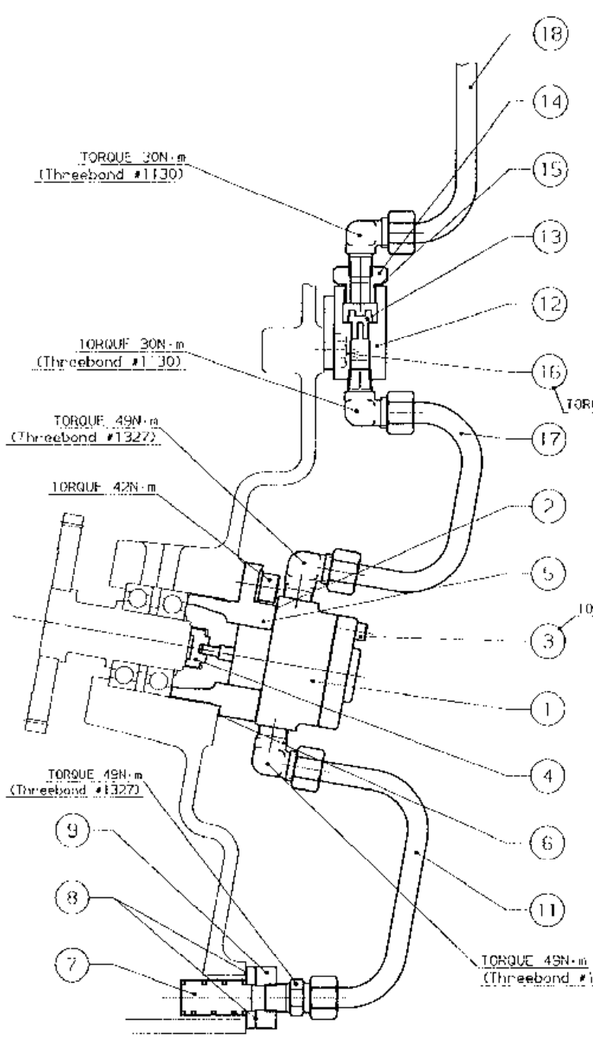
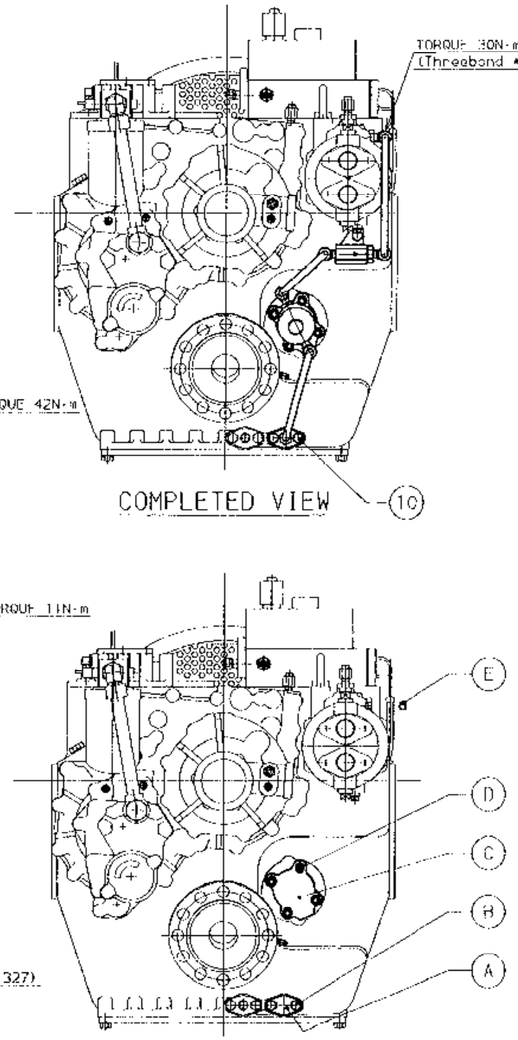


FIG. 2



COMPLETED VIEW

FIG. 1

	ITEM	PARTS NO.	N A M E	Q'TY	REMARKS
ⓐ	1	1-53114-F	PUMP, TROCHOID	1	
	2	E 52905-B	GASKET	1	
ⓑ	3	N113006060	SCREW, SOCKET HEAD	3	
	4	1-11017-C	COUPLING, OLDHAM	1	
	5	1-77901	MOUNT AS. PUMP	1	
	6	1-77302	GASKET	1	
	7	1-11045-C	STRAINER	1	
	8	1-59793-A	GASKET	2	
	9	1-59795-B	FLANGE	1	
	10	N085310035	SCREW, HEX.HEAD	2	
	11	1-78400	PIPING AS.	1	
	12	1-59981-A	CASE AS.	1	
	13	101012-A	VALVE, NONRETURN	1	
	14	J 53302-B	PLUG, HEX.HEAD	1	
	15	N370102015	GASKET, COPPER	1	
	16	N085710035	SCREW, HEX.HEAD	1	
	17	1-78401	PIPING AS.	1	
	18	1-78402	PIPING AS.	1	

INSTALLATION WORK SHOULD BE MADE AS PER THE FOLLOWING INSTRUCTIONS.

1. ITEMS TO BE NOTED AT THE INSTALLATION WORK
 (1) CIRCLED FIGURES INDICATE THE ADDITIONAL PARTS FOR THE INSTALLATION WORK. ALPHABETS INDICATE PRE-FITTED PARTS ON THE GEARBOX.
 (2) REFER TO THE ATTACHED FIGURES FOR THE EXACT INSTALLATION. TAKE CARE TO MATCH THE PATTERNS OF GASKETS WITH THOSE OF THE PARTS TO BE ATTACHED.
 (3) BEFORE THE INSTALLATION, REMOVE THE DUST FROM THE PARTS BY OIL WASHING AND AIR BLOWING.
 (4) WHEN THE PIPING ARE HARD TO INSTALL, TRY AGAIN AFTER ADJUSTING THE LOCATION OF THE BASE PARTS BY LOOSING THEIR SCREWS.

2. REMOVALS OF THE PROTECTED PARTS
 (1) REMOVE COVER Ⓐ, Ⓒ AND PLUG Ⓕ.
 (2) KEEP SCREWS Ⓓ FOR REUSE AT THE INSTALLATION OF THE TRAILING PUMP KIT.

3. INSTALLATION OF TRAILING PUMP
 (1) INSTALLATION OF TRAILING PUMP
  A. ATTACH PUMP BASE ⑤ WITH GASKET ⑥ BY SCREWS Ⓒ.
  B. ATTACH OLDHAM COUPLING ④ TO THE SHAFT BY USING GREASE DURING THE OLDHAM COUPLING AND THE SHAFT TO PREVENT OIL COUPLING FALL.
  C. INSTALL PUMP ① WITH GASKET ② BY SCREWS ③. IN THIS WORK, MAKE SURE THAT THE HOLE OF THE GASKET MEETS THE HOLE OF THE PUMP BASE.
 (2) ASSEMBLY OF NONRETURN VALVE
  A. INSERT NONRETURN VALVE ⑬ TO CASE ⑫ AND THEN TIGHTEN PLUG ⑭ SECURELY.
  B. INSERT STRAINER ⑦ TO THE GEARBOX AND INSTALL CASE ⑨ WITH GASKETS Ⓑ.
  C. INSTALL PIPING ASSEMBLY ⑰, ⑱ AND ⑯ ON THE GEARBOX.

THE INSTALLATION WORK IS COMPLETED.

NOTE: THE STRAINER SHALL BE CLEANED EVERY TIME AT CHANGING OIL.

BOM NO. 5703776

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

REV	BY	APPD.	REV	ZONE	CH. NO.	DATE	REV	ZONE	CH. NO.	DATE
a	T.WATANABE		a	B4	HK12158	011127				

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MATERIAL

HEAT TREAT

SURFACE TREATMENT

Rose	Wt	
	kg	in³

FIRST USE

ASSY. MODEL MG-6449-00-A

NAME OPTION KIT (TRAILING PUMP KIT)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.10
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 01-11-00
SCALE 1:2
DRN. T.WATANABE
CHK. K.Nelson
APPD. Y.Ishizuka

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

5-49402

SHEET 1 OF 1 REV ___

A2T

D C B A

6

5

4

3

2

1

E

D

C

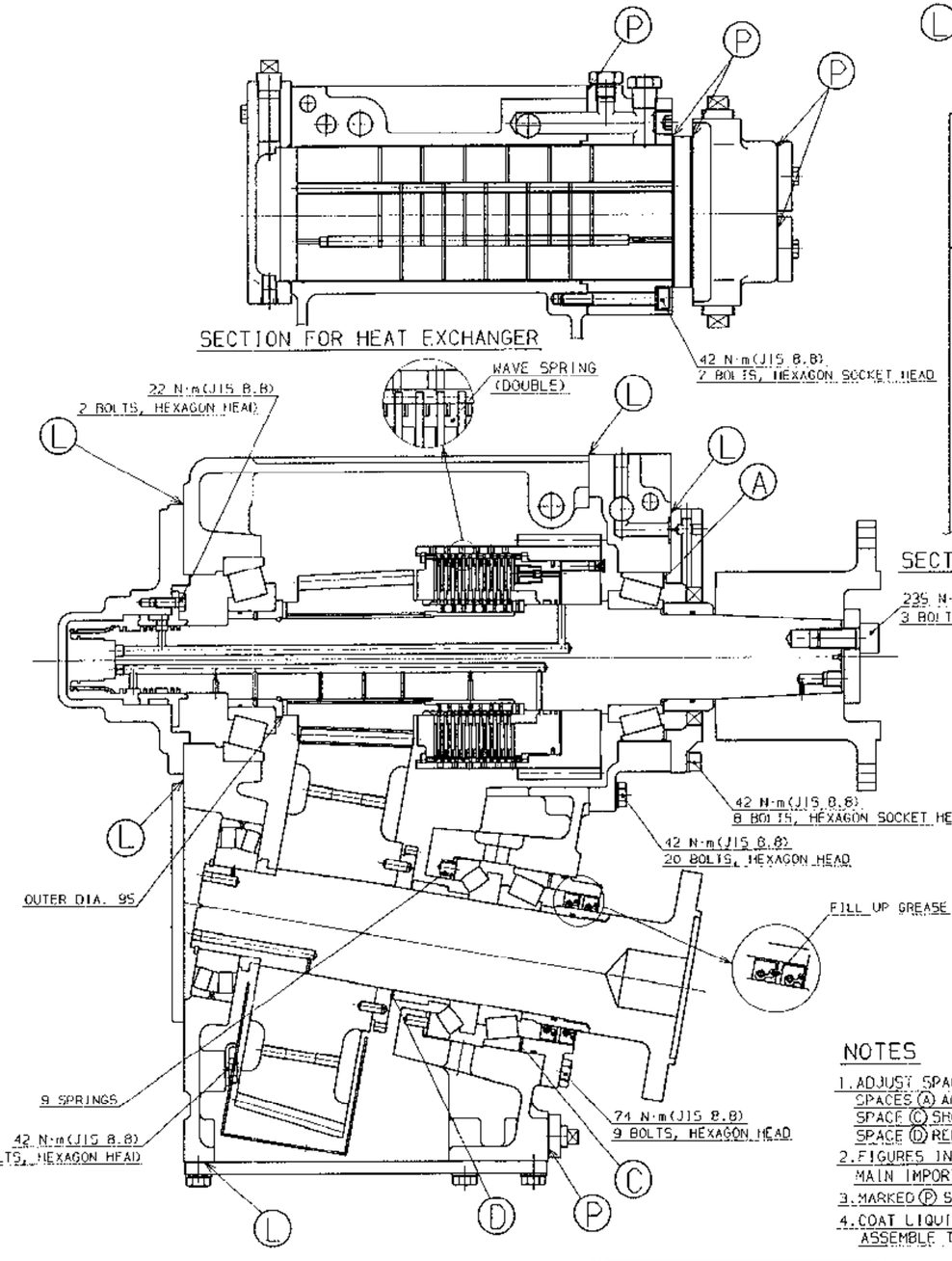
B

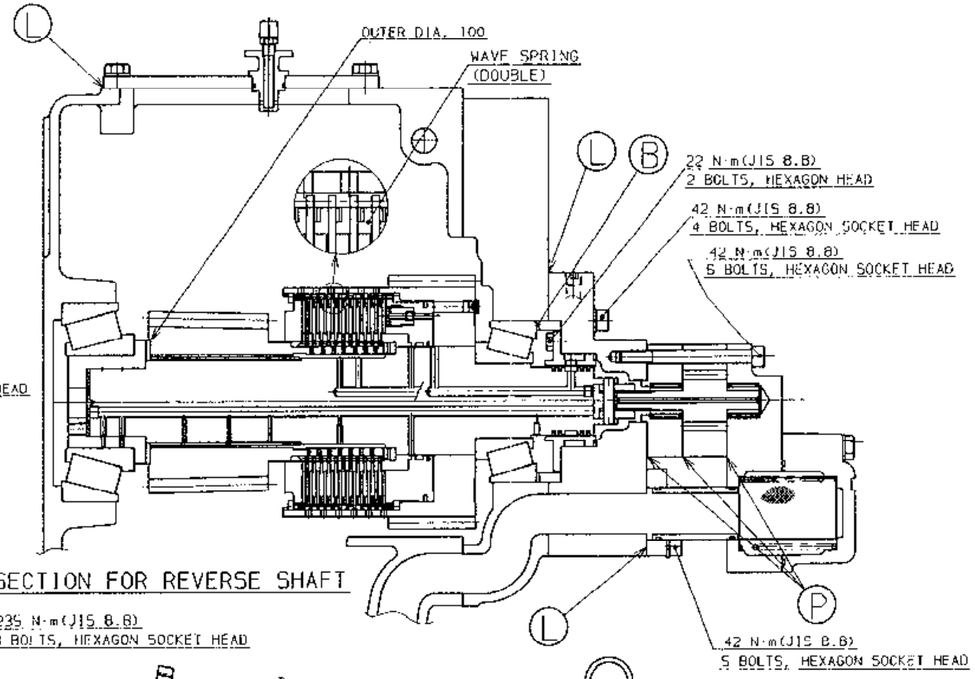
A

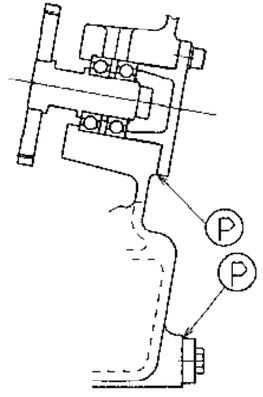
TWIN DISC

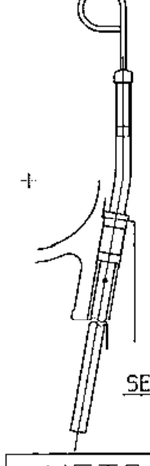
A7119W

DIAGRAM, HYDRAULIC
(WITHOUT TROLLING VALVE)









NOTES

1. ADJUST SPACES (A), (B), (C) AND (D) FOR EACH SHAFT WITH SHIMS.
   SPACES (A) AND (B) SHOULD BE -0.05 ~ +0.05 mm.
   SPACE (C) SHOULD BE 0 ~ +0.05 mm.
   SPACE (D) REFERS TO OTHER DRAWING 3-50178-A
2. FIGURES IN THE DRAWING SHOW TIGHTENED TORQUE FOR MAIN IMPORTANT BOLTS.
3. MARKED (P) SHOWS SEAT PACKINGS.
4. COAT LIQUID PACKING ON THE PORTION MARKED (L) AND ASSEMBLE THEM.

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

REV	BY	APPD.	DATE

REV	ZONE	CH. NO.	DATE	REV	ZONE	CH. NO.	DATE
		*******				*******	
		*******				*******	
		*******				*******	
		*******				*******	
		*******				*******	
		*******				*******	

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TWIN DISC, INCORPORATED
RACINE, WI 53403 - USA
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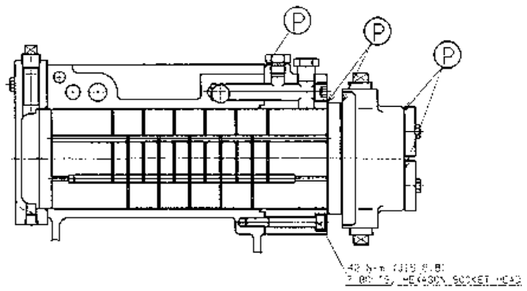
MATERIAL: -	MASS: XXXX kg	WR²: kg·m²	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm. MACHINED DIMENSIONS X. ±0.75, X.X ±0.25, X.XX ±0.13. ALL ANGULAR TOLERANCES ±1°. GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982
HEAT TREAT: - -	FIRST USE: ASSY. MODEL MG-6449-00-RV		DATE: 990909
SURFACE TREATMENT:	NAME: SECTIONAL VIEW		SCALE: 1:3
			DRN. o.yagi
			CHK. K.Sakamoto
			APPD. E.Nakanishi

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

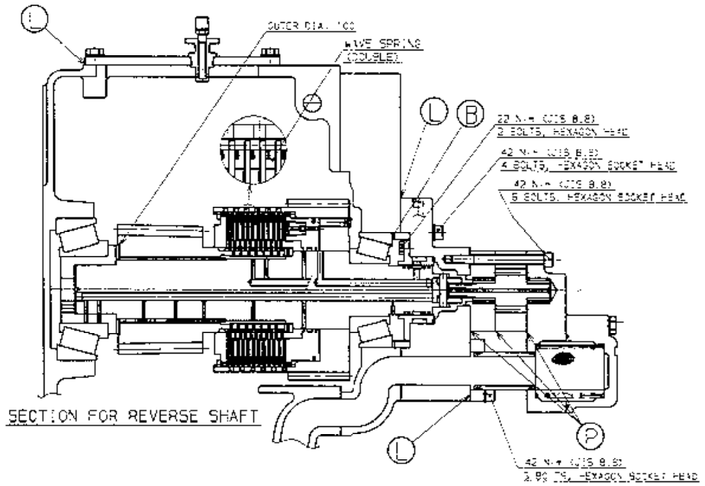
5-49607-A

SHEET 1 OF 1 | REV ---

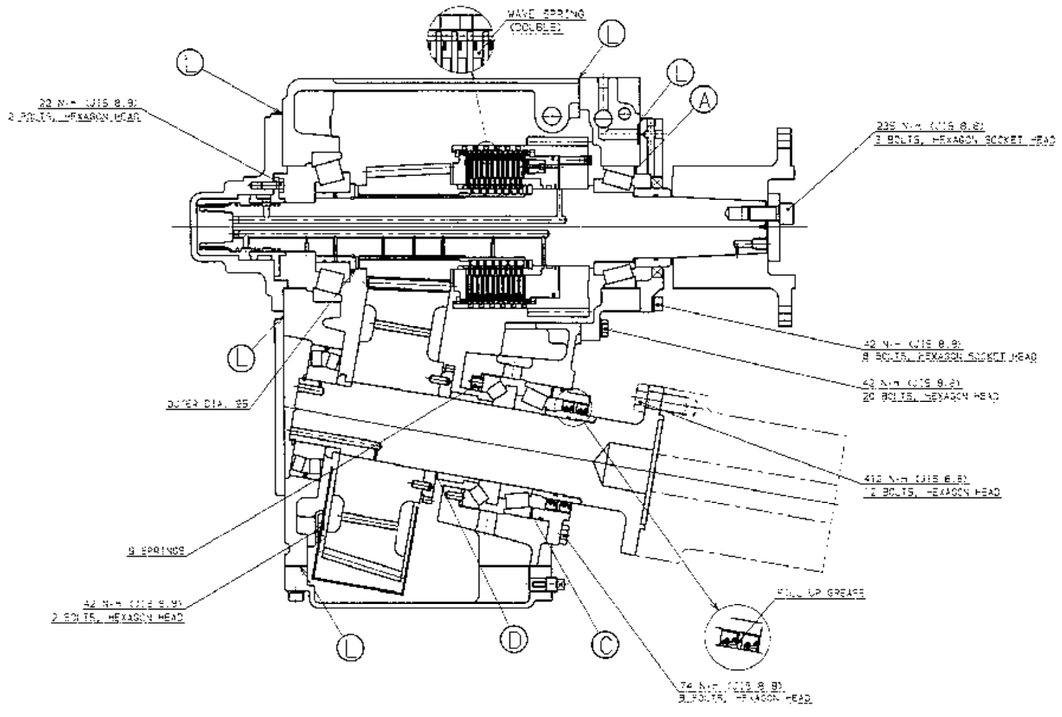
A2T

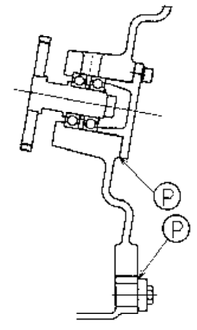


SECTION FOR HEAT EXCHANGER

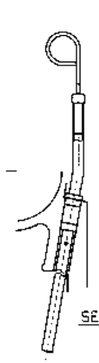


SECTION FOR REVERSE SHAFT





SECTION FOR TRAILING PUMP



SECTION FOR ATTACHING
OIL LEVEL GAUGE

NOTES

1. ADJUST SPACERS (A), (B), (C) AND (D) FOR EACH SHAFT WITH SHIMS.
SPACER (A) AND (B) ENDPLAY BE -0.05 ~ -0.05 mm.
SPACER (C) BE 0 ~ +0.05 mm.
SPACE (D) REFERRE TO OTHER DRAWING 3-50178-A
2. USE WASHER IN THE DRAWING WHEN TIGHTENING TORQUE FOR MAIN IMPORTANT BOLTS.
3. MARKED (E) SHOWS SEAT PACKINGS.
4. COAT LIQUID PACKING ON THE PORTION MARKED (C) AND ASSEMBLE IT.

REV	BY	APPD.

REV	ZONE	CH. NO.	DATE
		*******	
		*******	
		*******	
		*******	
		*******	
		*******	

REV	ZONE	CH. NO.	DATE
		*******	
		*******	
		*******	
		*******	
		*******	
		*******	

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MATERIAL: -
HEAT TREAT: -
SURFACE TREATMENT: -

MASS: XXXX kg
FIRST USE
ASSY.
MODEL MG-6145B-CO-RV

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MACHINED DIMENSIONS
X. ±0.25
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

NAME: SECTIONAL VIEW

DATE: 09-14-00
SCALE: 1:3
DRN. T. TOMOMATSU
CHK. S. SUGA
APPD.

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

7-38166

SHEET 1 OF 1 | REV ___

A1T

MG 6449 00-RV MARINE GEAR SPECIFICATIONS					
GEAR RATIO		1.51	1.73	2.00	2.44	2.95
TOTAL MASS		APPROX. 325 KG (DRY)				
OIL QUANTITY		APPROX. 18 L				
OIL PRESSURE		MIN. AT 2,100 R.P.M. (AT RATED ENGINE SPEED)				
		LUBE OIL: 2.2 BAR MIN. (ENGINE SPEED)				
OIL VISCOSITY		SAE #40 (DRY) USE MULTI-GRADE OIL				
OIL, GREASE & SPIN ON ELEMENT CHANGE INTERVAL		THE FIRST OIL CHANGE AT 100 HOURS OF OPERATION AND SUBSEQUENTLY EVERY 1000 HOURS OF OPERATION				
RELIEF VALVE PRESS.		8.4 BAR MAX.				
STRAINER		WIRE NETTING				
SHIFTING ALL ROTATION		SHIFT TO FORWARD OR REVERSE FROM NEUTRAL AND SHIFT ACROSS NEUTRAL SHALL BE MADE AT ENGINE SPEED LOWER THAN 50% OF THE RATED SPEED				
HEAT EXCHANGER		WATER FLOW (RAW WATER)				60-80 L/MIN.
		TEMPERATURE OF COOLING WATER MAX.				32 °C

OPTIONAL VIEW DWG NO.	5-45507-A
GEAR PUMP GUTH WIDTH	25 mm

DETAIL OF SELECTOR VALVE
(VIEW B)

SECTION A-A

COOLING WATER INLET AND OUTLET FLANGE

DETAIL OF OUTPUT FLANGE

MARINE GEARS
(OPERATING VOLTAGE = 24VDC)

	CONNECTOR
PORT "A" SOLENOID	A
PORT "B" SOLENOID	B
NEUTRAL SOLENOID	C
	D
	E
	F

MARKED S SHOWS STAINLESS STEEL BOLTS

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REV	BY	APPR.	DATE

MATERIAL	MASS XXXX kg	WT lb
HEAT TREAT	FIRST USE	
SURFACE TREATMENT	ASSY. MODEL MG-6449-00-RV	
	NAME GENERAL VIEW	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MACHINED DIMENSIONS
X ±0.2
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

DATE	882838
SCALE	1:4.5
DRN.	BLEB
CHK. W.B.	
APPD.	
SHEET 1 OF 1	REV

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

7-37431-B

A1T

MG-8449-00-RV MARINE GEAR SPECIFICATIONS	
GEAR RATIO	
TOTAL MASS	APPROX. 485 kg (1070 lbs)
OIL QUANTITY	APPROX. 18 L (4.8 US GAL)
OIL PRESSURE	0.3-0.6 MPa (3.0-6.0 kg/cm²) (43-86 PSI) AT 2100 RPM
OIL VISCOSITY	SAE 30 (0.3-0.6 MPa (3.0-6.0 kg/cm²) (43-86 PSI) AT 2100 RPM)
OIL GRADE & CHANGE INTERVAL	USE ONLY API CLASSIFIED CD OR HIGHER GRADE OIL. DO NOT USE ANY SPECIAL ADDITIVES. CHANGE OIL AND REPLACE FILTER ELEMENT EVERY 1000 HOURS OF OPERATION.
OIL CAPACITY	6.0 L (1.6 US GAL) MIN. 8.0 L (2.1 US GAL) MAX.
OPERATION	ASTERN OPERATION NOT RECOMMENDED
ROTATION	CLOCKWISE (VIEWED FROM REAR OF ENGINE)
RESTRICTION	AXIAL SHIFT AHEAD WHILE ENGINE IS RUNNING IS NOT AT ENGINE SPEED UNDER LOAD. USE OF THE NEUTRAL POSITION IS REQUIRED.
HEAT EXCHANGER	WATER FLOW (RAW WATER) 60 L/MIN (15.9 US GPM) MAX. 40 °C (104 °F) TEMPERATURE OF RAW COOLING WATER MAX. 40 °C (104 °F)

DETAIL OF SELECTOR VALVE (VIEW B)

DETAIL OF CLOGGING INDICATOR

SECTION A-A

COOLING WATER INLET AND OUTLET FLANGE

DETAIL OF OUTPUT FLANGE

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MATERIAL

HEAT TREAT

SURFACE TREATMENT

MASS XXXX kg

FIRST USE

ASSY. MODEL MG-8449-00-RV

NAME GENERAL VIEW

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X ±0.25
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

DATE 27-10-16

SCALE 1:4.5

DRN. T. Yamashita

CHK. K. Sakamoto

APPD. K. Sakamoto

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

7-38165 A

SHEET 1 OF 1 REV ---

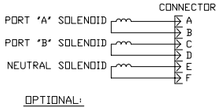
REV	BY	APPD.	DATE

REV	ZONE	CH. NO.	DATE

REV	ZONE	CH. NO.	DATE

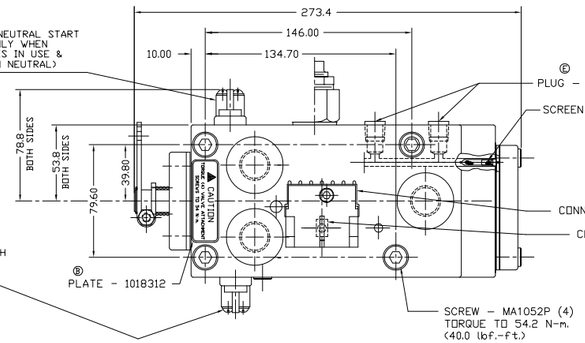
A1T

WIRING DIAGRAM:



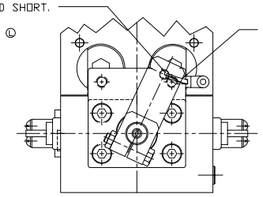
OPTIONAL:
MATING WIRING HARNESS 1017403 SERIES (SPECIFY LENGTH).

MANUAL OVERRIDE NEUTRAL START SWITCH (CLOSED ONLY WHEN MANUAL OVERRIDE IS IN USE & TRANSMISSION IS IN NEUTRAL) MAX. I = 20 A.

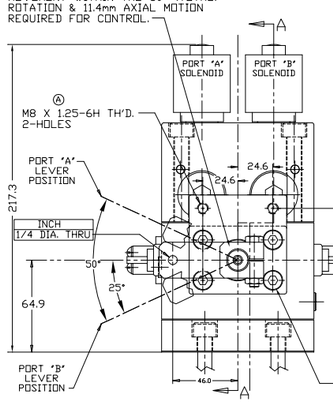

273.4
146.00
134.70
10.00
78.8 BOTH SIDES
53.8 BOTH SIDES
39.80
79.60
Ⓔ PLUG – M2051K (2)
SCREEN – 1020479 (AG)
CONNECTOR, SHROUD -- 1001825
CLIP, CONNECTOR -- 1017322
ELECTRIC CONTROL MODE SWITCH (CLOSED WHEN MANUAL VALVE STEM IS LOCKED IN ELECTRIC MODE.) MAX. I = 20 A.
Ⓑ PLATE – 1018312
SCREW – MA1052P (4) TORQUE TO 54.2 N-m. (40.0 lbf.-ft.)

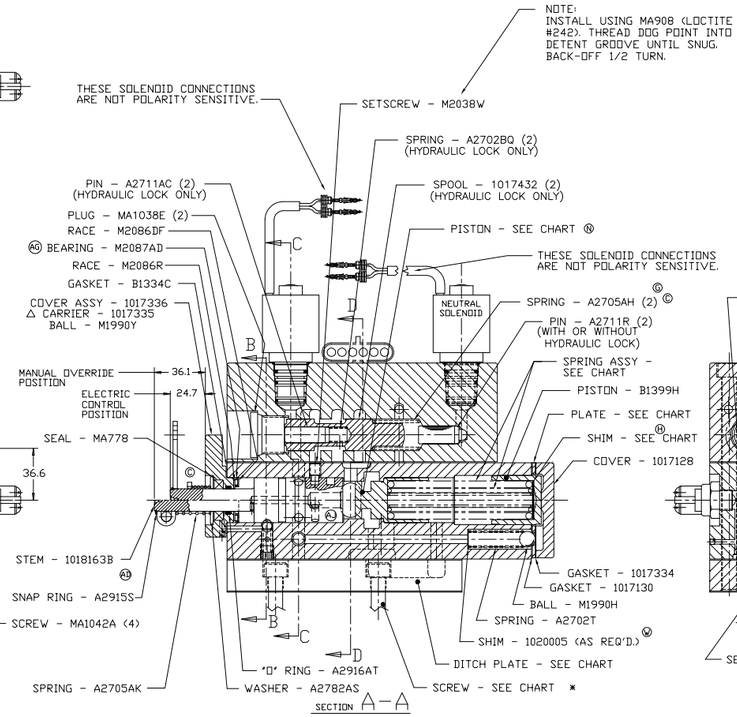
TOP VIEW

NOTE:
SECURE LEVER IN THE DEPRESSED 'ELECTRIC CONTROL MODE' POSITION BY LOOPING PLASTIC STRAP THRU 1/4" HOLE IN LEVER & M8 THREADED HOLE BEHIND – PULL TIGHT, TRIM END SHORT.

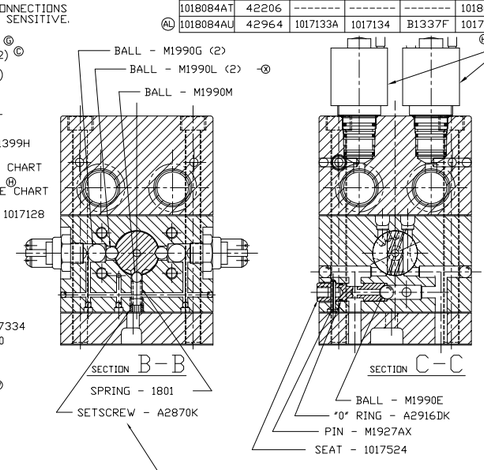


NOTE:
LEVER MAY BE LOCATED ANYWHERE ON ITS SHAFT THAT PERMITS FREE MOVEMENT WITHIN THE 50° (TOTAL) ROTATION & 11.4mm AXIAL MOTION REQUIRED FOR CONTROL.

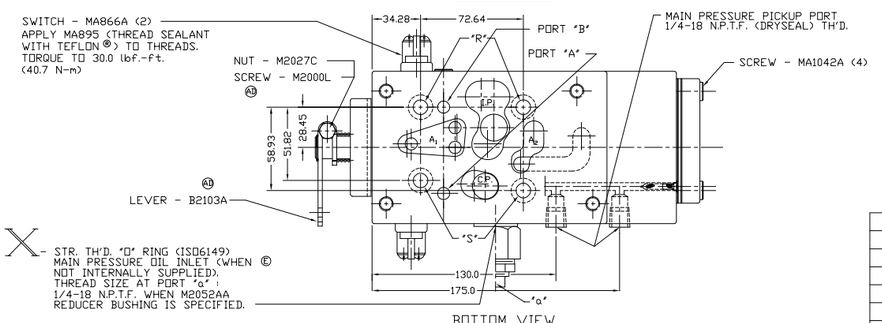



THESE SOLENOID CONNECTIONS ARE NOT POLARITY SENSITIVE.
SETSCREW – M2038W
SPRING – A2702BQ (2) (HYDRAULIC LOCK ONLY)
PIN – A2711AC (2) (HYDRAULIC LOCK ONLY)
PLUG – MA1038E (2)
RACE – M2086DF
Ⓐⓖ BEARING – M2087AD
RACE – M2086R
GASKET – B1334C
COVER ASSY – 1017336
△ CARRIER – 1017335
BALL – M1990Y
SPOOL – 1017432 (2) (HYDRAULIC LOCK ONLY)
PISTON – SEE CHART Ⓝ
THESE SOLENOID CONNECTIONS ARE NOT POLARITY SENSITIVE.
SPRING – A2705AH (2) Ⓒ
PIN – A2711R (2) (WITH OR WITHOUT HYDRAULIC LOCK)
SPRING ASSY – SEE CHART
PISTON – B1399H
PLATE – SEE CHART
SHIM – SEE CHART Ⓗ
COVER – 1017128
MANUAL OVERRIDE POSITION
ELECTRIC CONTROL POSITION
36.1
24.7
SEAL – MA778
STEM – 1018163B
Ⓐⓗ
SNAP RING – A2915S
SCREW – MA1042A (4)
SPRING – A2705AK
"O" RING – A2916AT
WASHER – A2782AS
GASKET – 1017334
GASKET – 1017130
BALL – M1990H
SPRING – A2702T
SHIM – 1020005 (AS REQ'D.) Ⓦ
DITCH PLATE – SEE CHART
SCREW – SEE CHART *
NEUTRAL SOLENOID
SECTION A–A

NOTE:
INSTALL USING MA908 (LOCTITE #242). THREAD DOG POINT INTO DETENT GROOVE UNTIL SNUG. BACK-OFF 1/2 TURN.



NOTE:
INSTALL USING MA908 (LOCTITE #242) TOP OF SCREW MUST BE FLUSH WITH SURFACE.

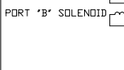


X – STR. TH'D. "O" RING (ISO6149) MAIN PRESSURE OIL INLET (WHEN Ⓔ NOT INTERNALLY SUPPLIED). THREAD SIZE AT PORT 'a' : 1/4-18 N.P.T.F. WHEN M2052AA REDUCER BUSHING IS SPECIFIED.

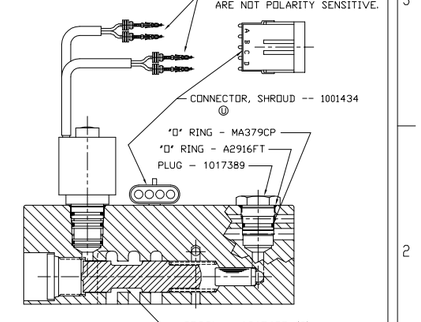
	VALVE ASS'Y No.	BOM No.	DITCH PLATE No.	DITCH PLATE GASKET	TRANSMISSION GASKET	PISTON	HYD-RAULIC LOCK?	SOLENOID QTY.	SOLENOID No.	VOLTAGE	VALVE SPRINGS SPRING ASS'Y	VALVE SPRINGS CONSISTS OF : OUTER	VALVE SPRINGS CONSISTS OF : INNER	CLUTCH kPa (PSI) NOM.	ORIFICE PLATE No.	X	SHIMS PART NO.	SHIMS APPY. QTY.	MOUNTING SCREWS "R" ×	MOUNTING SCREWS QTY.	MOUNTING SCREWS "S" ×	MOUNTING SCREWS QTY.	FIRST USE	DATE AND APPR.
(AE)(AA)	1018084	40750	1017133	1017134	B1337F	1018688	YES	3	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		MA1052A	2	MA1052A	2	MG-5202DC	3-17-98 DAS/BJE
(AL)	1018084A	40751	------	1017383	------	1017179	NO	2	XM2759FM	24 VDC	-------	A2707BD	A2704BU	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		------		------		MG-6619RV	3-17-98 DAS/BJE
(AA)	1018084B	40752	1017133	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	-------	A2707AD		1585 (230)	1017129A	M2051L MA1053G / M2052AA	B2451B		M2089F	2	M2089AG	2	DD-514V	3-17-98 DAS/BJE
□	1018084C	40753	1017133	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	XA2707BZ	A2707BW	A2703BA	1380 (200)	1017129	M2051L MA1053G / M2052AA	B2451B		M2089Y	1	M2089F	3	DD-516V	3-17-98 DAS/BJE
(AA)	1018084D	40754	1017133	1017134	B1337F	1017179	NO	2	XM2759FL	12 VDC	-------	A2707AD		1585 (230)	1017129A	M2051L MA1053G / M2052AA	B2451B		M2089F	2	M2089AG	2	DD-514V	3-17-98 DAS/BJE
□	1018084E	40755	1017133	1017134	B1337F	1017179	NO	2	XM2759FL	12 VDC	XA2707BZ	A2707BW	A2703BA	1380 (200)	1017129	M2051L MA1053G / M2052AA	B2451B		M2089Y	1	M2089F	3	DD-516V	3-17-98 DAS/BJE
(AA)	1018084F	40756	1017133A	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		M2089F	2	M2089F	2	MG-5111	3-17-98 DAS/BJE
(AA)	1018084G	40757	1017133A	1017134	B1337F	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		M2089F	2	M2089F	2	MG-5111	3-17-98 DAS/BJE
(P)(F)	1018084H	40758	1017583	1017569	1017613	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062G	2	MG-5600	3-17-98 DAS/BJE
(P)(F)	1018084J	40761	1017583	1017569	1017613	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062G	2	MG-5600	3-17-98 DAS/BJE
(AA)	1018084K	40762	1017133A	1017134	B1337F	1017179	NO	2	XM2759FM	24 VDC	--------	A2707AD		1585 (230)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		MA1052B	2	MA1052B	2	MG-5114	3-17-98 DAS/BJE
(AL)(AA)	1018084L	40763	1017133A	1017134	B1337F	1017179	NO	2	XM2759FL	12 VDC	--------	A2707AD		1585 (230)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	MA1052B	2	MA1052B	2	MG-5114	3-17-98 DAS/BJE
(AL)(F)	1018084M	40764	--------	1017383	--------	1018688	NO	2	XM2759FM	24 VDC	--------	A2702BC	A2704BU / A2707AX	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		------		------		MG-6984 61242	3-17-98 DAS/BJE
(Z)(P)(F)	1018084N	40775	1017583	1017569	1017613	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062J	2	MG-5600DR	4-8-98 DAS
(AA)(T)(Q)(M)(F)	1018084P	40817	--------	--------	--------	1018688	NO	2	XM2759FM	24 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		------		------		MG-6650SC	7-23-98 DAS/AZ
(AE)(AA)(K)	1018084Q	40842	1017133	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	USE AS REQUIRED	MA1052K	2	MA1052K	2	MG-5202SC	8-5-98 DAS/RM
(V)	1018084R	40935	--------	1017383	--------	1017179	YES	3	XM2759FM	24 VDC	--------	A2707BD	A2704BU	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B		------		------		MG-6557	10-9-98 JHB/DAS
(AC)(AA) □	1018084S	40954	1018584	1018594	B3117A	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B		M1732AH	2	M1732AH	2	MG-540	11-6-98 DAS/BJE
(AL)	1018084T	40955	--------	1017383	--------	1017179	NO	2	XM2759FM	24 VDC	--------	A2707BD A2702BC	A2704BU	2655 (385)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	5	------		------		MG-6449	11-6-98 DAS/BJE
(AH)(AF)(W)	1018084U	40956	--------	1017383	--------	1017179	NO	2	XM2759FM	24 VDC	--------	A2707BD A2702BC	A2704BU	2550 (370)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	4	------		------		MG-6557	11-6-98 DAS/BJE
(AL)(AF)	1018084V	40957	--------	1017383	--------	1017179	NO	2	XM2759FM	24 VDC	--------	A2707AX A2702BC	A2704BU	2450 (355)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	5	------		------		MG-6600 MG-6619	11-6-98 DAS/BJE
(AE)(AA)(J)	1018084W	40958	1017133	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	MA1052A	2	MA1052A	2	MG-5202DC	11-18-98 VR/VTV
(AA)	1018084X	40964	1017133A	1017134	B1337F	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	M2089AR	2	M2089AR	2	MG-5141	11-24-98 RM/VTV
(T)(M)(Q)	1018084Y	41028	--------	--------	--------	1018688	NO	2	XM2759FL	12 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-6650SC	12-7-98 DJM/DAS
(AA)(R)	1018084Z	41045	--------	1017134	--------	1018688	NO	2	XM2759FM	24 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5205DC	2-18-99 JS/BJE
(Z)	1018084AA		1017583	1017569	1017613	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	0	MA1062B	2	MA1062J	2	MG-5600DR	
(AE)(AA)	1018084AB	41093	1017133	1017134	B1337F	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	MA1052A	2	MA1052A	2	MG-5202DC	5-26-99 JS/VTV
(AL)(AH)	1018084AC	40967	--------	1017383	--------	1017179	YES	3	XM2759FM	24 VDC	--------	A2702BC	A2707BD A2704BU	2655 (385)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	5	------		------		MG-6449-RV	7-9-99 JS/DAS
(S)(D)	1018084AD	41114	------	------	------	1018688	NO	2	XM2759FL	12 VDC	--------	A2702BC	A2707BD A2704BU	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-6848SC	8-2-99 ALC/DAS
(S)(D)	1018084AE	41115	------	------	------	1018688	NO	2	XM2759FM	24 VDC	--------	A2702BC	A2707BD A2704BU	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-6848SC	8-2-99 ALC/DAS
(AE)(AA)	1018084AF	41118	1017133	1017134	B1337F	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	MA1052K	2	MA1052K	2	MG-5202SC	8-11-99 JS/DAS
(AE)(AA)	1018084AG	41163	--------	1017134	--------	1018688	NO	2	XM2759FL	12 VDC	XA2707AD	A2707AD	A2703AB	2000 (290)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5205DC	11/19/99 ALC/DAS
(AG)(V)	1018084AH	41171	--------	--------	--------	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5170DC	11/19/99 ALC/DAS
(AA)(V)	1018084AJ	41172	--------	--------	--------	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5170DC	11/19/99 ALC/DAS
(AC)(AA)(W) □	1018084AK	41244	1018584	1018594	B3117A	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	M1732AH	2	M1732AH	2	MG-540	2/11/00 ALC/DAS
(AK)(AA) □	1018084AL	41250	--------	--------	--------	1018688	NO	2	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-520-1HP	2/11/00 ALC/DAS
(AK)(AA) □	1018084AM	41251	--------	--------	--------	1018688	NO	2	XM2759FL	12 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-520-1HP	2/11/00 ALC/DAS
(AA)	1018084AN	41196	--------	--------	--------	1017179	NO	2	XM2759FM	24 VDC	--------	A2707AD	A2703BA	1860 (270)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5141SC	3/21/00 ALC/DAS
(AA)	1018084AP	41195	--------	--------	--------	1017179	NO	2	XM2759FL	12 VDC	--------	A2707AD	A2703BA	1860 (270)	1017129A	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5141SC	3/21/00 ALC/DAS
(AF)(W)	1018084AQ	41337	--------	1017383	--------	1017179	YES	3	XM2759FM	24 VDC	--------	A2702BC	A2707BD A2704BU	2550 (370)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	4	------		------		MG-6557	4/24/00 AZ/ALC
(AL)(AF)	1018084AR	41446	--------	1017383	--------	1017179	YES	3	XM2759FM	24 VDC	--------	A2702BC	A2707AX A2704BU	2450 (355)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	5	------		------		MG-6600 MG-6619	6/21/00 DJM/ALC
(AK)	1018084AS	41718	--------	--------	--------	1018688	YES	3	XM2759FM	24 VDC	XA2707Z	A2707Z	A2703T	1725 (250)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-5170DC	4/21/00 JS/ALC
	1018084AT	42206	------	------	------	1018688	YES	3	XM2759FM	24 VDC	--------	A2702BC	A2707BD A2704BU	2415 (350)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	------		------		MG-6848SC	10-17-02 DJM/ALC
(AL)	1018084AU	42964	1017133A	1017134	B1337F	1017179	YES	3	XM2759FM	24 VDC	--------	A2707AD		1585 (230)	1017129B	MA1038E(M27 X 2.0-6H)	B2451B	AS REQ.	MA1052B	2	MA1052B	2	MG-5114	6-11-04 DJM/ALC

PARTS FOR UNITS WITHOUT NEUTRAL SOLENOID AND HYDRAULIC LOCK (OPTIONAL CONDITION)

WIRING DIAGRAM:



OPTIONAL:
MATING WIRING HARNESS 1017404 SERIES (SPECIFY LENGTH).



Ⓐⓑ □ OBSOLETE FOR PRODUCTION AND SERVICE

△ NOT SERVICEABLE SEPARATELY

* THESE PARTS ARE TO BE PACKAGED SEPARATELY AND SHIPPED WITH UNIT.

A_1 = ATMOSPHERIC PRESSURE
A_2 = ATMOSPHERIC PRESSURE
I.P. = INTERMEDIATE PRESSURE
C.P. = CLUTCH PRESSURE

HYDRAULIC DIAGRAM A7119W, SHEET 1 OF 2

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

REV	ZONE	CH. NO.	DATE
AL		ECN12514	6-23-04
AK		ECN11492	5-28-03
AJ	E3	ECN11238	12-20-02
AH		ECN10970	8-9-02
AG		ECN10415	1-11-02
AF	A-4,-5	ECN10553	12-3-01

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THIS NOTICE IS NOT INTENDED TO NULLIFY OR LIMIT RIGHTS GRANTED TO THE U.S. GOVERNMENT OR OTHERS BY CONTRACT.

MATERIAL: ---------
HEAT TREAT: ----------
SURFACE TREATMENT:
WEIGHT kg / WR² N·m²
FIRST USE: ASSY. 1015207 MODEL MG-5202DC
NAME: VALVE ASS'Y. – CONTROL (WITHOUT TROLLING VALVE)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS: X ±0.75; X.X ±0.25; X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

DATE 3-23-98
SCALE .50 = 1.00
DRN. RM
CHK. RM/BJE
APPD. DAS

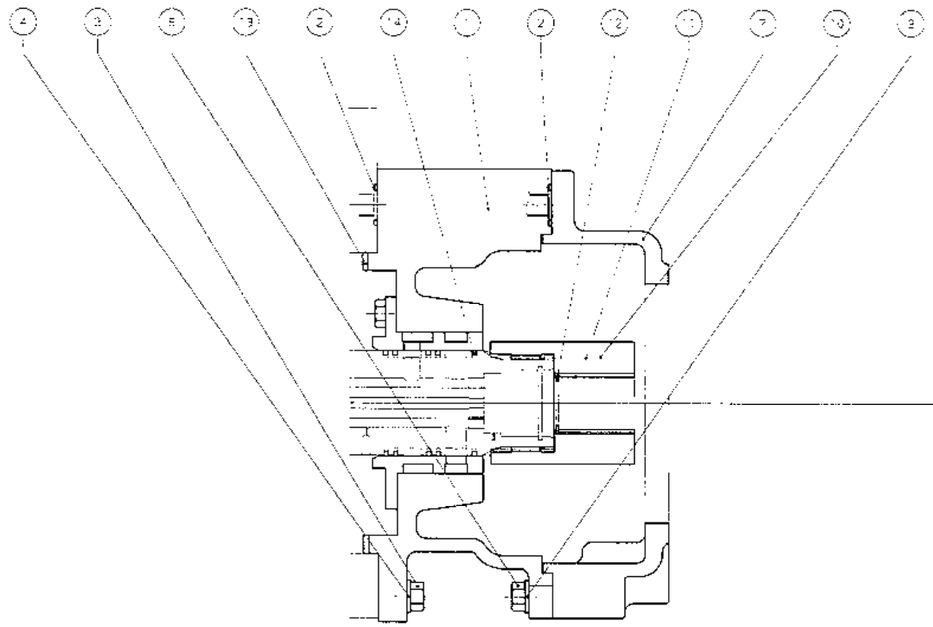
TWIN DISC INCORPORATED RACINE, WI 53403 – USA

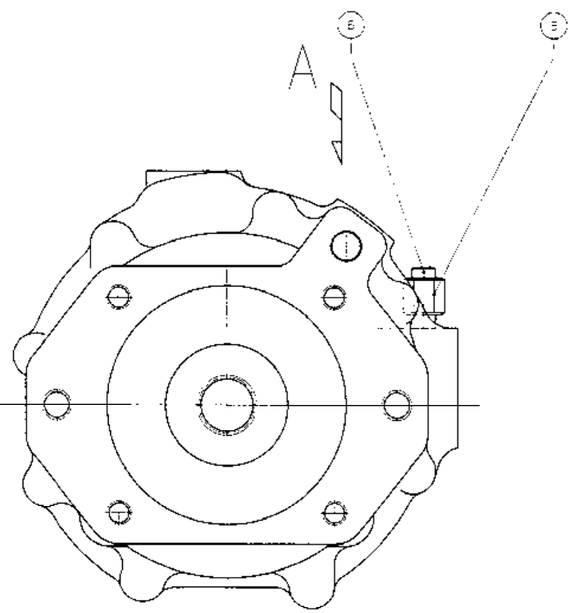
1018084 SERIES

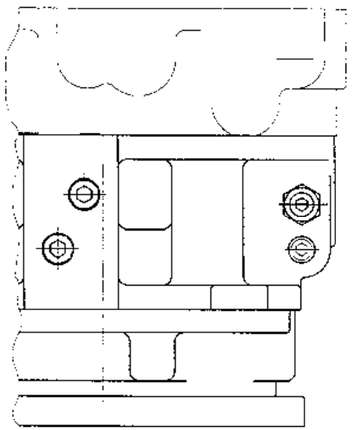
SHEET 1 OF 1 REV AL

F E D C B A

ITEM	PARTS NO.	N A M E	Q'TY	REMARKS
1	1-77858--	COVER AS., SUPPLY	1	
2	NC48002055	RING, "O"	6	
3	NC87710035	SCREW, HEX.-HEAD	8	
4	NC32010000	WASHER	8	
5	1-71628-B	ADAPTOR	1	
6	1-71822-A	PLUG, TAPER	1	
7	1-78028	COVER AS.	1	
8	NC87710035	SCREW, HEX.-HEAD	8	
9	NC32010000	WASHER	8	
10	1-77182-A	SLEEVE AS., PUMP	1	INCLUDES NO.10 & 11
11	3-48410	SLEEVE	1	
12	NC58002800	RING, SNAP	1	
13	N46015B318	SHIM	1 SET	
14	N41200S824	RING, OIL SEAL	5	







VIEW A

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

NOTICE! THIS PRINT CONTAINS PROPRIETARY INFORMATION AND IS NOT TO BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF TWIN DISC, INCORPORATED RACINE, WI 53403 - USA
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MATERIAL -

HEAT TREAT -

SURFACE TREATMENT -

MASS XXXX KG

FIRST USE

ASS'Y.

MODEL MG-8449-DD-A

NAME LIVE PTO AS.

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN
MACHINED DIMENSIONS
X ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING
PER ANSI Y14.5M-1982

DATE 20103'

SCALE 1:1.4

DRN. HARUYAMA

CHK.

APPD.

7-37639

SHEET 1 OF 1 REV ---

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

REV	BY	APPD.

REV	ZONE	CH. NO.	DATE
	*******		
	*******		
	*******		
	*******		
	*******		
	*******		

REV	ZONE	CH. NO.	DATE
	*******		
	*******		
	*******		
	*******		
	*******		
	*******		

A1T

SPLINE DATA	
	24/48
	4
NOMINAL PITCH CIRCLE DIA.	25.933
PRESS. ANGLE	30°

SECTION D-D

SECTION A-A

DETAIL E

SECTION B-B

SECTION C-C

VIEW F

OPTION KIT BOM NO. 5203775-1

ITEM	PARTS NO.	NAME	QTY	REMARKS
1		GASKET	1	
2		COVER, REAR	1	
3		SCREW, HEX HEAD	5	
4		SCREW, HEX	2	
5		SCREW	2	
6		WASHER, LOCK	2	
7		PLATE, NAME	1	
8		RIVET, BLIND	4	
9		SCREW, HEX HEAD	2	INCLUDED FROM 1 TO 20
10		WASHER, LOCK	2	
11		SCREW, HEX HEAD	2	
12		PLUG, PIPE	1	
13		PLUG, PIPE	1	
14		SCREW, SOCKET HEAD	6	EXTERNAL SEPARATION
15		SCREW, SOCKET HEAD	6	INTERNAL SEPARATION
16		WASHER, LOCK	2	
17		HOUSING	1	
18		SEAL, OIL	1	
19		BEARING	1	
20		RING, RETAINING	1	
21		SPACER	1	
22		GEAR	1	
23		KEY	1	
24		RING, SNAP	1	
25		BEARING	1	
26		WASHER, THRUST	1	
27		SCREW, HEX HEAD	2	
28		RETAINER, BALL	1	
29		GEAR	1	
30		SHAFT	1	
31		GASKET, SEALANT	1	
32		COVER	1	
33		PLUG	1	INCLUDED FROM 32 TO 40
34		VALVE, RELIEF	1	
35		SPRING	1	
36		PLUG, TAPER	1	
37		SCREW	1	
38		PLUG	1	
39		SCREW	1	
40		SPRING	1	
41		PISTON	1	
42		SCREW, HEX HEAD	1	
43		SCREW, HEX HEAD	2	
44		SCREW	2	
45		WASHER, LOCK	2	
46		SCREW, HEX HEAD	1	
47		SCREW, HEX HEAD	8	
48		SCREW	8	
49		SCREW, HEX HEAD	8	
50		PLUG	1	
51		WASHER, LOCK	1	
52		SCREW, HEX HEAD	2	
53		SCREW, HEX HEAD	3	INCLUDED FROM 41 TO 53
54		PLUG	1	
55		SCREW, HEX HEAD	1	
56		WASHER, LOCK	1	
57		SCREW, HEX HEAD	1	
58		SCREW, SOCKET HEAD	1	
59		SCREW, HEX HEAD	1	
60		SCREW, HEX HEAD	1	
61		PLUG	1	
62		SCREW, SOCKET HEAD	1	
63		SCREW, HEX HEAD	1	
64		PLUG	1	
65		SCREW, HEX HEAD	1	
66		WASHER, LOCK	1	
67		SCREW, HEX HEAD	1	
68		SCREW, SOCKET HEAD	1	
69		PLUG	1	
70		SCREW, HEX HEAD	1	
71		PLUG	1	
72		SCREW, SOCKET HEAD	1	
73		SCREW, SOCKET HEAD	1	
74		PLUG	1	
75		SCREW, SOCKET HEAD	1	
76		SCREW, HEX HEAD	1	
77		SCREW, HEX HEAD	1	

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

SIZE D

NOTICE: THIS PRINT CONTAINS PROPRIETARY INFORMATION AND IS NOT TO BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF TWIN DISC, INCORPORATED RACINE, WI 53403 USA
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REV	BY	APPD.

REV	ZONE	CH. NO.	DATE
		*******	
		*******	
		*******	
		*******	
		*******	
		*******	

REV	ZONE	CH. NO.	DATE
		*******	
		*******	
		*******	
		*******	
		*******	
		*******	

MATERIAL: -

HEAT TREAT: -

SURFACE TREATMENT: -

WEIGHT: XXXX lb

FIRST USE

MODEL 760-8448-00C-RV

NAME: CLUTCHABLE PTO ASS'Y

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MACHINED DIMENSIONS X ±.12, X.X ±.06, X.XX ±.015. ALL ANGULAR TOLERANCES ±1°. GEOMETRIC TOLERANCING PER ANSI Y14.5M-1982

DATE: 02-15-01

SCALE: .12

DRN:

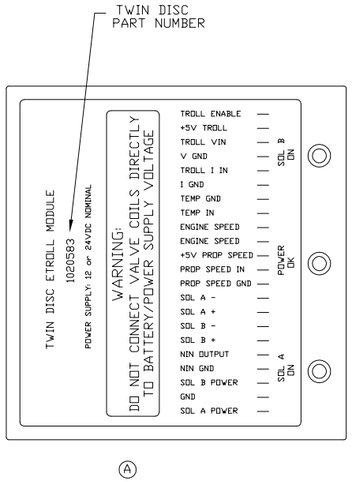
CHK:

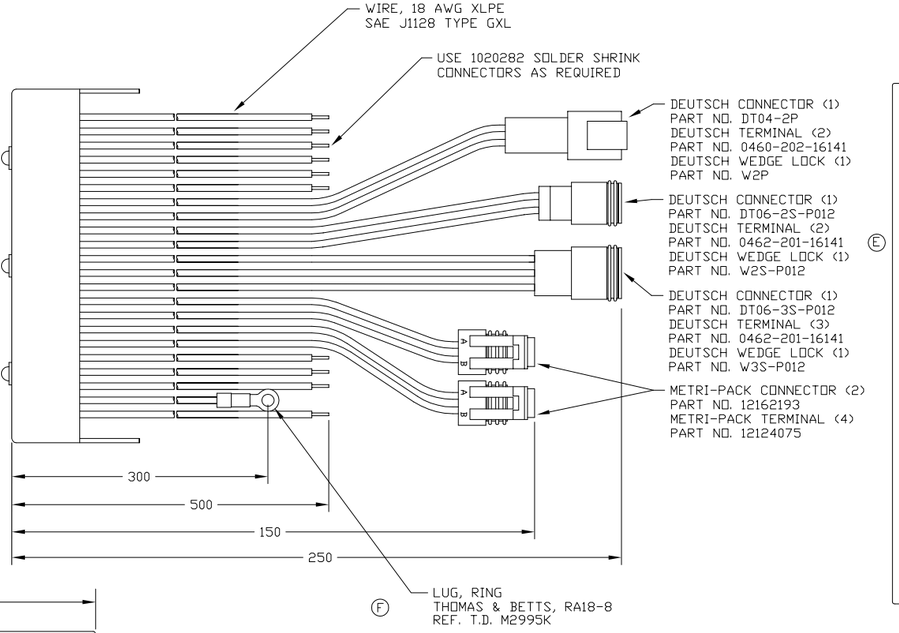
APPD:

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

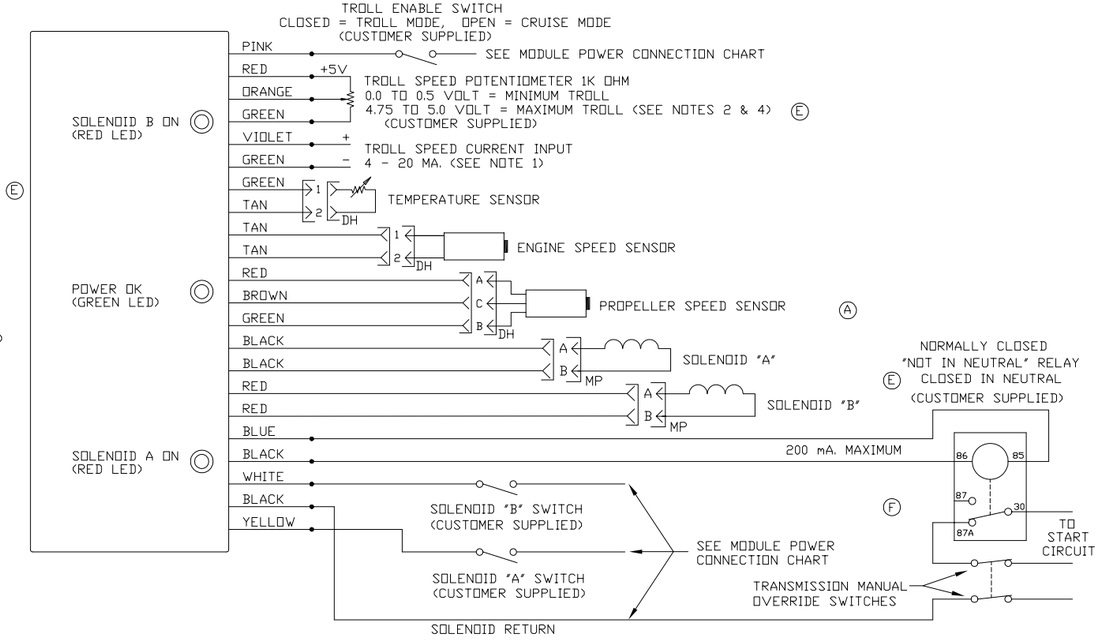
7-36957-E

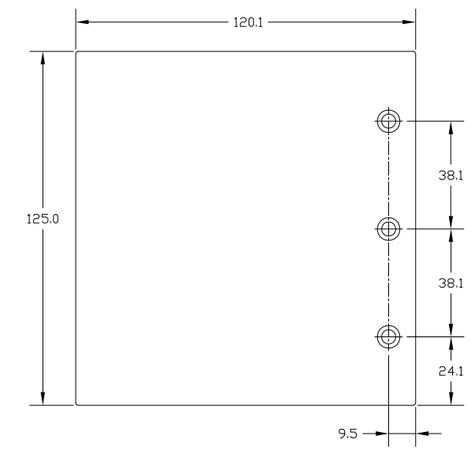
SHEET 1 OF 1 REV ___

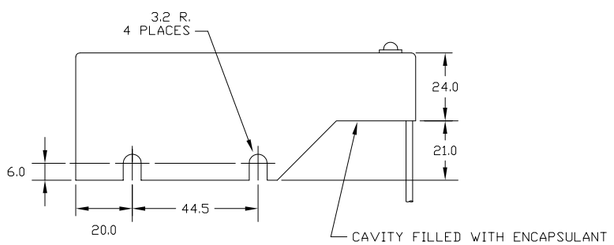




WIRING SCHEMATIC







MODULE COVER
STAINLESS STEEL
.06 (1.5mm) THICK
Ⓑ

MODULE POWER CONNECTION CHART

USE OPTION 1 CONNECTIONS WHEN THE MODULE IS CONNECTED TO NON-ELECTRONIC LEVER HEADS.

USE OPTION 2 CONNECTIONS WHEN THE MODULE IS CONNECTED TO ELECTRONIC GEAR CONTROLLERS.

USE OPTION 3 CONNECTIONS WHEN THE MODULE IS CONNECTED TO ELECTRONIC CONTROL SOLENOID DRIVER OUTPUTS. THE ELECTRONIC CONTROL'S SOLENOID 'A' AND 'B' RETURNS OR NEGATIVE SIGNALS SHOULD BE CONNECTED TOGETHER AND CONNECTED TO THE 'ETROLL' MODULE RETURN. ELECTRONIC CONTROL SOLENOID DRIVERS MUST HAVE THEIR SOLENOID RETURN INTERNALLY CONNECTED DIRECTLY TO GROUND. IF NOT, THE MODULE MUST BE INTERFACED TO THE ELECTRONIC CONTROL WITH RELAYS.

WIRE	WIRING OPTION 1	WIRING OPTION 2	WIRING OPTION 3
TROLL ENABLE SWITCH RETURN	CONNECT TO THE NEGATIVE TERMINAL OF THE ENGINE BATTERY	CONNECT TO THE SAME GROUND POINT USED BY THE GEAR CONTROLLER OR THE ENGINE CONTROL.	CONNECT TO THE SAME POINT AS THE CONTROL'S POWER GROUND SIGNAL
SOLENOID B SWITCH	CONNECT TO THE POSITIVE TERMINAL OF THE ENGINE BATTERY THROUGH THE SWITCH CONTACTS USED TO ENERGIZE SOLENOID B.	CONNECT TO THE OUTPUT IN THE GEAR CONTROLLER THAT IS USED TO ENERGIZE SOLENOID B.	CONNECT TO THE CONTROL'S SOLENOID B POSITIVE DRIVER OUTPUT.
SOLENOID RETURN	CONNECT TO THE NEGATIVE TERMINAL OF THE ENGINE BATTERY	CONNECT TO THE SAME GROUND POINT USED BY THE GEAR CONTROLLER OR THE ENGINE CONTROL.	CONNECT TO THE CONTROL'S SOLENOID NEGATIVE OUTPUT CIRCUIT.
SOLENOID A SWITCH	CONNECT TO THE POSITIVE TERMINAL OF THE ENGINE BATTERY THROUGH THE SWITCH CONTACTS USED TO ENERGIZE SOLENOID A.	CONNECT TO THE OUTPUT IN THE GEAR CONTROLLER THAT IS TO ENERGIZE SOLENOID A.	CONNECT TO THE CONTROL'S SOLENOID A POSITIVE DRIVER OUTPUT.

NOTE: FOR USE ON NOMINAL 12/24 VDC SYSTEMS.

Ⓐ

LED INDICATORS
- GREEN LED ILLUMINATED WHEN POWER IS GREATER THAN 9.0 VOLTS
- RED LED ILLUMINATED INDICATES VALVE COIL COMMANDED ON.
- ONE RED FLASHING INDICATES AN OPEN CIRCUIT IN AN ENERGIZED VALVE COIL CIRCUIT, VALVE COIL LEADS SHORTED TOGETHER, OR LOW COIL CURRENT.
- RED LEDS FLASH SIMUTAINIOUSLY AFTER ENTERING TROLL FROM NEUTRAL WITH BOTH VOLTAGE AND CURRENT TROLL SPEED SIGNALS PRESENT OR WHEN POWER IS APPLIED TO SOLENOID 'A' AND 'B' SWITCH INPUTS AT THE SAME TIME.
- RED ALTERNATELY FLASHING INDICATES EITHER OR BOTH SPEED SIGNALS MISSING

NOTE 1: WHEN TROLL SPEED CURRENT INPUT IS USED TO CONTROL TROLL SPEED, THE ORANGE AND GREEN TROLL SPEED POTENTIOMETER INPUT WIRES MUST BE ELECTRICALLY CONNECTED TOGETHER WITH A SOLDER SHRINK CONNECTOR AND SECURED. THE RED WIRE MUST BE INSULATED AND ALL 3 WIRES SECURED.

NOTE 2: WHEN TROLL SPEED VOLTAGE INPUT IS USED TO CONTROL TROLL SPEED, THE VIOLET AND GREEN WIRES MUST BE INSULATED AND SECURED.

Ⓐ Ⓔ NOTE 3: PROPELLER SPEED SENSOR MUST BE TWIN DISC SUPPLIED PART.

NOTE 4: TO INITIATE TROLL WITHOUT THE 0.5 VOLT DEAD BAND AT MINIMUM TROLL, ADD A 100 OHM RESISTOR BETWEEN THE POTENTIOMETER AND THE GREEN WIRE.

NOTE 5: WHEN THE 'NOT IN NEUTRAL' CIRCUIT IS NOT USED, INSULATE AND SECURE THE BLUE AND BLACK WIRES.

PART NO.	FACTORY SETTINGS
1020583	SEE PAGE 2
1020583A	
1020583B	
1020583C	
1020583D	

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

• = WIRE SPLICE PART # 1020282
DH = DEUTSCH CONNECTOR
MP = METRIPACK CONNECTOR

REV	SHEET	ZONE	CH. NO.	DATE
F	1&2		ECN12521	6-30-04
E	1&2		ECN11890	10-15-03
D	1&2		ECN11590	6-03-03
C	1&2		ECN11452	5-22-03
B	1		ECN11523	4-29-03
A	1&2		ECN11418	4-22-03

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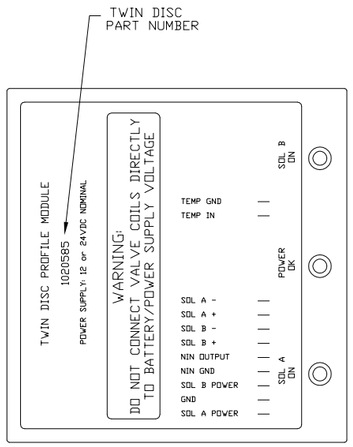
MATERIAL	SEE NOTE
HEAT TREAT	
SURFACE TREATMENT	
WEIGHT kg	WR² N m²
FIRST USE	
ASSY.	
MODEL	
NAME	CONTROL (MG ETROLL MODULE)
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm	
MACHINED DIMENSIONS X. ±0.75 XX ±0.25 XXX ±0.13	
ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982	
DATE	7-16-02
SCALE	1 = 1
DRN.	W.Russell
CHK.	R.N.Schenk
APPD.	M.B.Gee

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1020583 SERIES

SHEET 1 OF 2 REV F



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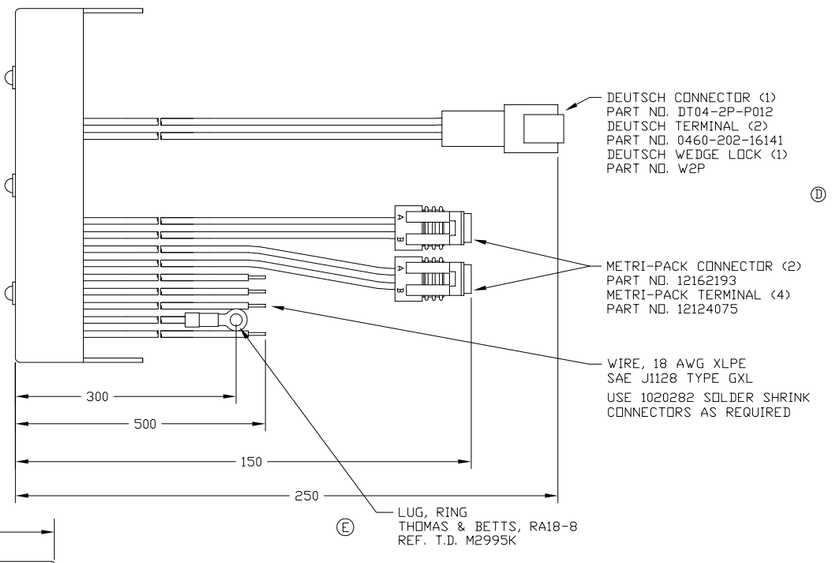

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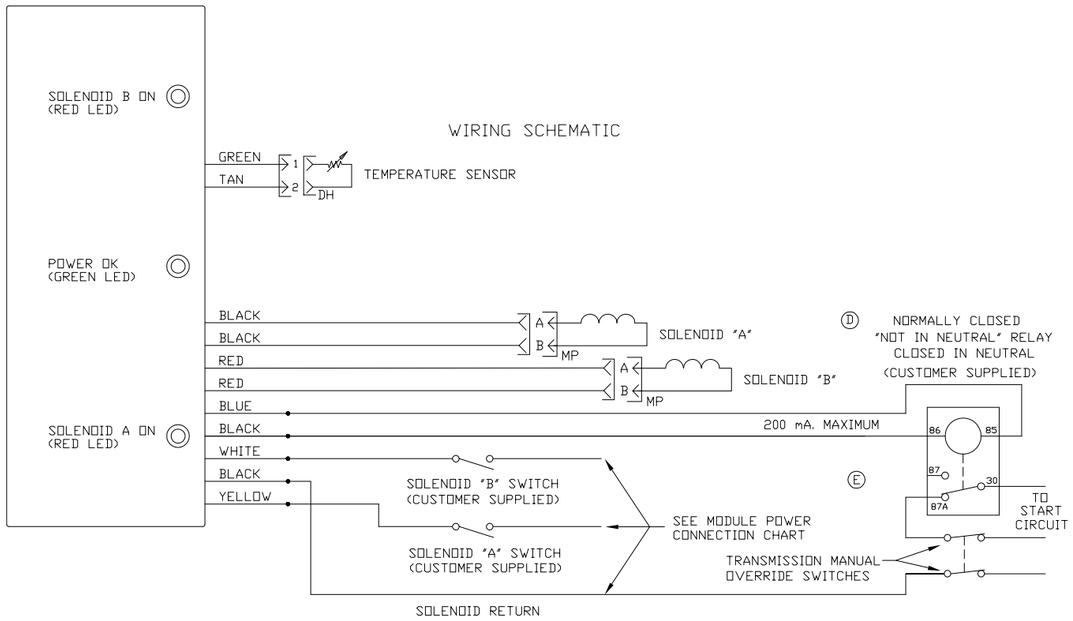

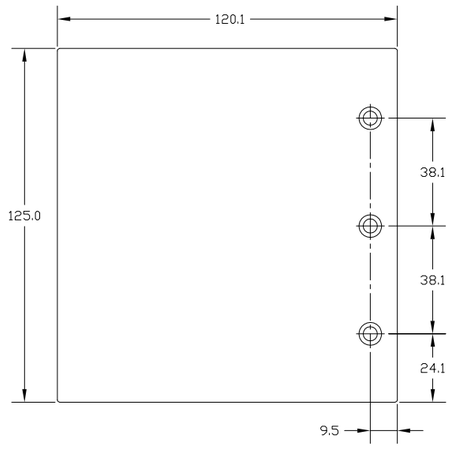

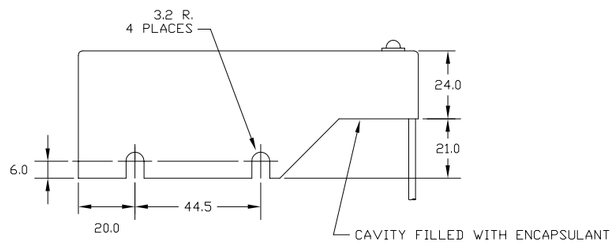

MODULE COVER
STAINLESS STEEL
.06 (1.5mm) THICK

Ⓑ

MODULE POWER CONNECTION CHART

USE OPTION 1 CONNECTIONS WHEN THE MODULE IS CONNECTED TO NON-ELECTRONIC LEVER HEADS.

USE OPTION 2 CONNECTIONS WHEN THE MODULE IS CONNECTED TO ELECTRONIC GEAR CONTROLLERS.

USE OPTION 3 CONNECTIONS WHEN THE MODULE IS CONNECTED TO ELECTRONIC CONTROL SOLENOID DRIVER OUTPUTS. THE ELECTRONIC CONTROL'S SOLENOID 'A' AND 'B' RETURNS OR NEGATIVE SIGNALS SHOULD BE CONNECTED TOGETHER AND CONNECTED TO THE 'ETROLL' MODULE RETURN. ELECTRONIC CONTROL SOLENOID DRIVERS MUST HAVE THEIR SOLENOID RETURN INTERNALLY CONNECTED DIRECTLY TO GROUND. IF NOT, THE MODULE MUST BE INTERFACED TO THE ELECTRONIC CONTROL WITH RELAYS.

WIRE	WIRING OPTION 1	WIRING OPTION 2	WIRING OPTION 3
SOLENOID B SWITCH	CONNECT TO THE POSITIVE TERMINAL OF THE ENGINE BATTERY THROUGH THE SWITCH CONTACTS USED TO ENERGIZE SOLENOID B.	CONNECT TO THE OUTPUT IN THE GEAR CONTROLLER THAT IS USED TO ENERGIZE SOLENOID B.	CONNECT TO THE CONTROL'S SOLENOID B POSITIVE DRIVER OUTPUT.
SOLENOID RETURN	CONNECT TO THE NEGATIVE TERMINAL OF THE ENGINE BATTERY	CONNECT TO THE SAME GROUND POINT USED BY THE GEAR CONTROLLER OR THE ENGINE CONTROL.	CONNECT TO THE CONTROL'S SOLENOID NEGATIVE OUTPUT CIRCUIT.
SOLENOID A SWITCH	CONNECT TO THE POSITIVE TERMINAL OF THE ENGINE BATTERY THROUGH THE SWITCH CONTACTS USED TO ENERGIZE SOLENOID A.	CONNECT TO THE OUTPUT IN THE GEAR CONTROLLER THAT IS TO ENERGIZE SOLENOID A.	CONNECT TO THE CONTROL'S SOLENOID A POSITIVE DRIVER OUTPUT.

NOTE: FOR USE ON NOMINAL 12/24 VDC SYSTEMS.

LED INDICATORS
- GREEN LED ILLUMINATED WHEN POWER IS GREATER THAN 9.0 VOLTS
- RED LED ILLUMINATED INDICATES VALVE COIL COMMANDED ON.
- ONE RED FLASHING INDICATES AN OPEN CIRCUIT IN AN ENERGIZED VALVE COIL CIRCUIT, VALVE COIL LEADS SHORTED TOGEATHER, OR LOW COIL CURRENT.
- RED LEDS FLASH SIMUTAINIOUSLY WHEN POWER IS APPLIED TO SOLENOID 'A' AND 'B' SWITCH INPUTS AT THE SAME TIME.

Ⓐ NOTE 1: TEMPERATURE SENSOR MUST BE A TWIN DISC SUPPLIED PART.

NOTE 2: WHEN THE 'NOT IN NEUTRAL' CIRCUIT IS NOT USED, INSULATE AND SECURE THE BLUE AND BLACK WIRES.

PART NO.	FACTORY SETTINGS
1020585	SEE PAGE 2
1020585A	
1020585B	

• = WIRE SPLICE PART # 1020282
DH = DEUTSCH CONNECTOR
MP = METRIPACK CONNECTOR

REV	SHEET	ZONE	CH. NO.	DATE
E	1 & 2		ECN12521	6-30-04
D	1 & 2		ECN11890	10-15-03
C	1 & 2		ECN11590	6-03-03
B	1	F1	ECN11523	4-29-03
A	1	F5	ECN11418	4-22-03

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RACINE, WI 53403 - USA
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MATERIAL	SEE NOTE
HEAT TREAT	
SURFACE TREATMENT	
WEIGHT kg	WR² N·m²
FIRST USE ASSY.	
MODEL	
NAME	CONTROL (MG PROFILE MODULE)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X. ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

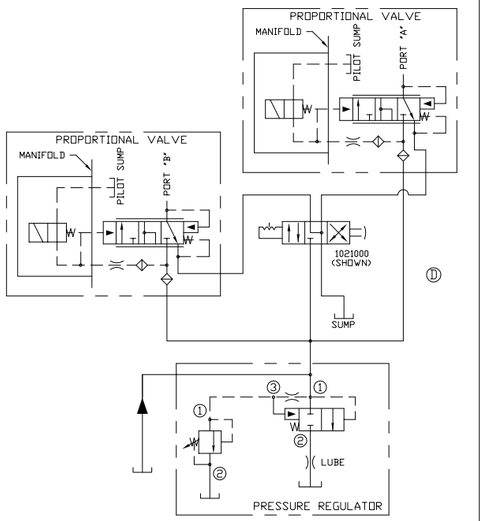
DATE	2-25-03
SCALE	1 = 1
DRN.	W.Russell
CHK.	R.N.Schenk
APPD.	M.B.Gee

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO

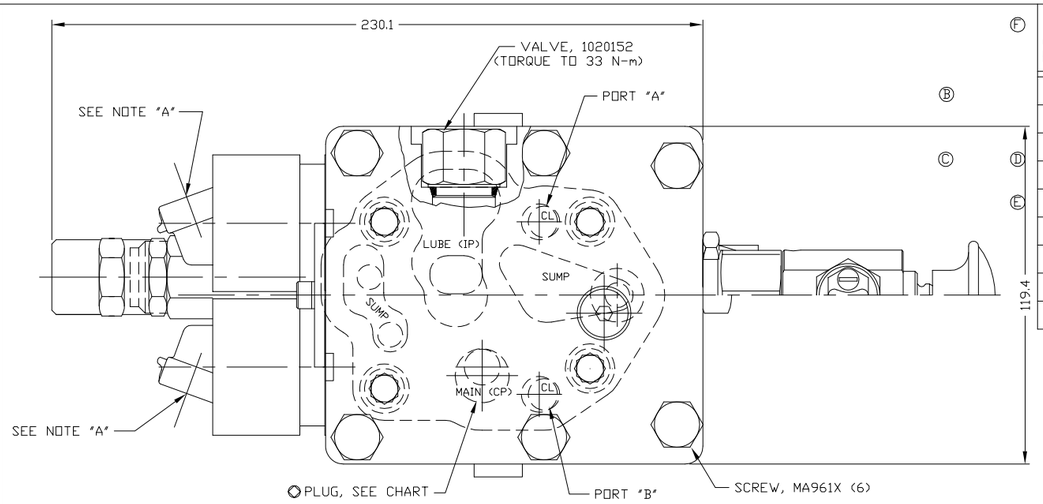
TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

1020585 SERIES

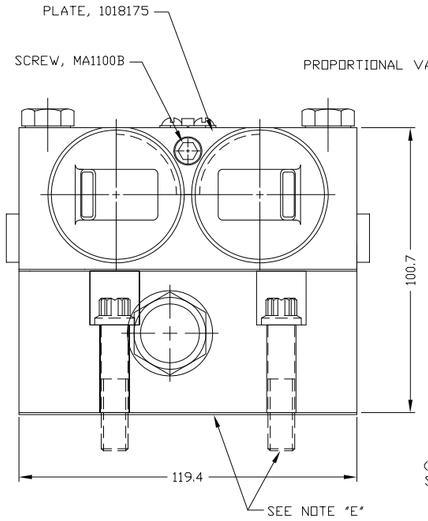
SHEET 1 OF 2 REV E

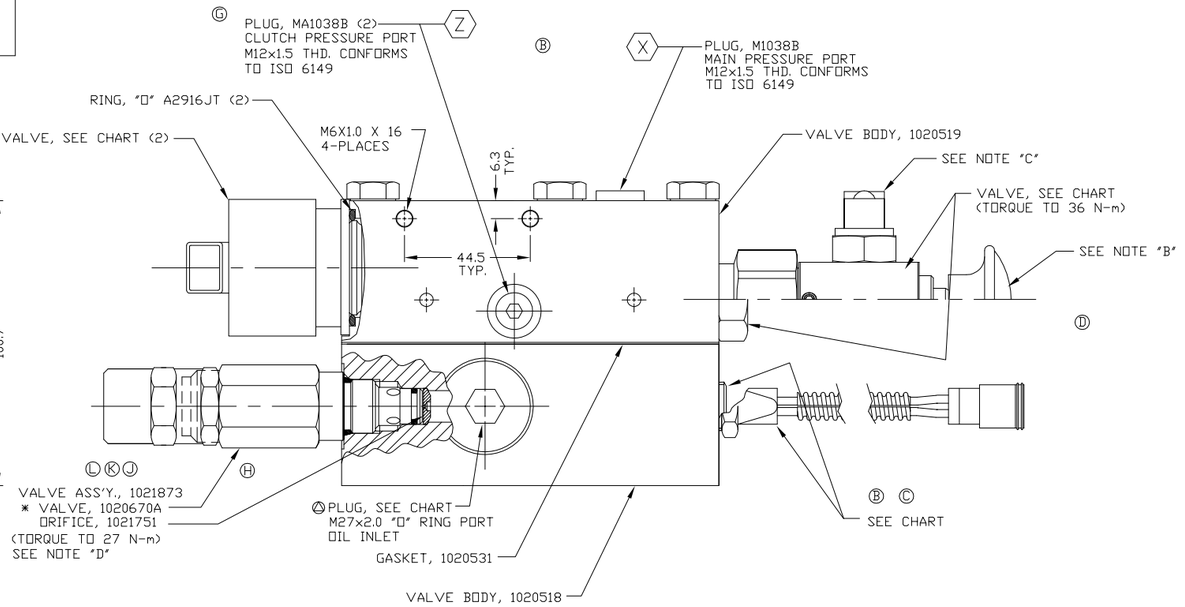


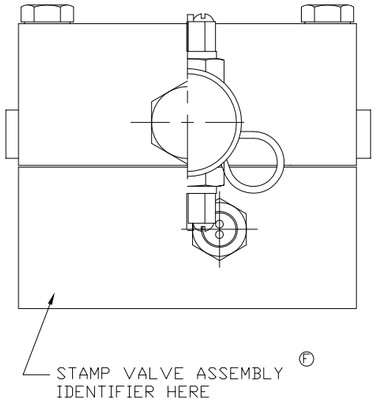
HYDRAULIC DIAGRAM (GRAPHIC SYMBOLS)



VALVE ASSEMBLY PART NO.	BOM	VALVE ASSEMBLY IDENTIFIER	VALVE Ⓛ	SENSOR	◇ PLUG	△ PLUG	CORE PLUG SEE NOTE "F"	PROPORTIONAL VALVE (PSI)
1020729A	42223	A	1021000A	1016122A	NONE	MA1038E	NONE	1020520 (350)
1020729B	42426	B	1021000A	1016122A	NONE	MA1038E	NONE	1018528 (250)
1020729C	42127	C	1021000A	NONE	M2051S	MA1038E	NONE	1018528 (250)
1020729D	42126	D	1021000A	NONE	M2051S	MA1038E	NONE	1020520 (350)
1020729E	42516	E	1020542	NONE	M2051S	MA1038E	M1945E PORT "A"	1018528 (250)
1020729F	42974	F	1021000A	NONE	M2051S	MA11185A	NONE	1018528 (250)




PLUG, MA1038B (2) CLUTCH PRESSURE PORT M12x1.5 THD. CONFORMS TO ISO 6149
RING, "O" A2916JT (2)
PROPORTIONAL VALVE, SEE CHART (2)
M6X1.0 X 16 4-PLACES
6.3 TYP.
PLUG, M1038B MAIN PRESSURE PORT M12x1.5 THD. CONFORMS TO ISO 6149
VALVE BODY, 1020519
SEE NOTE "C"
VALVE, SEE CHART (TORQUE TO 36 N-m)
SEE NOTE "B"
44.5 TYP.
VALVE ASS'Y., 1021873
* VALVE, 1020670A
ORIFICE, 1021751
(TORQUE TO 27 N-m)
SEE NOTE "D"
PLUG, SEE CHART M27x2.0 "O" RING PORT OIL INLET
GASKET, 1020531
VALVE BODY, 1020518
SEE CHART



NOTES :

A. PROPORTIONAL CONTROL VALVE OPERATION
   1. WARNING DO NOT CONNECT VALVE COIL DIRECTLY TO BATTTERY/POWER SUPPLY VOLATAGE.
   2. OPERATION TO BE PERFORMED WITH ONLY TWIN DISC CONTROL SYSTEMS OR MODULES.

B. MANUAL DIRECTIONAL CONTROL VALVE OPERATION
   1. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PUSH TO ENGAGE PORT "A"
   2. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PULL TO ENGAGE PORT "B"

C. MANUAL DIRECTIONAL CONTROL VALVE MODE SWITCH
   1. SWITCHES ARE NORMALLY CLOSED WHEN MANUAL DIRECTIONAL CONTROL VALVE IS IN THE CENTERED POSITION AND OPEN WHEN LEVER IS ACTUATED FROM CENTERED POSITION
   2. CURRENT = 20 AMPS MAX.
   3. FOR WIRING SCHEMATIC, REFER TO CONTROL MODULE DRAWING.

D. PRESSURE REGULATOR INITIAL ADJUSTMENT PROCEDURE
   1. WITH NO OIL FLOW TO VALVE, TURN ADJUSTMENT STEM OF THE 1020670A VALVE COUNTER-CLOCKWISE UNTIL REACHING POSITIVE STOP.
   2. WITH A MINIMUM OF 1 gpm, ALLOW OIL TO FLUSH PRESSURE RGEULATOR.
   3. AFTER FLUSHING, TURN ADJUSTMENT STEM OF THE 1020670A VALVE CLOCKWISE UNTIL REACHING REQURIED PRESSURE SPCIFIED IN MARINE TRANSMISSION PRODUCTION TEST SPECIFICATION.
   4. LOCK ADJUSTMENT STEM IN PLACE USING JAM NUT AND CAP.

E. REFER TO MARINE TRANSMISSION ASSEMBLY DRAWING OR BILL OF MATERIAL FOR VALVE MOUNTING GASKET AND SCREWS.

F. APPLY ANAEROBIC SEALANT MEETING M2828 REQUIREMENTS AROUND CORE PLUG, JUST BEFORE FINAL ASSEMBLY. REFER TO S774 FOR FURTHER INFORMATION.

* NOT SERVICEABLE SEPARATELY

Ⓑ REVISED AND REDRAWN - SUPERSEDES 1020729 DATED 8-9-02

Ⓜ OBSOLETE: REPLACED BY 1021658 FOR PRODUCTION AND SERVICE

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
M		A2	ECN12561	7-28-04	F		B6	ECN11978	11-18-03
L		B6 E2	ECN12457	5-28-04	E		B6	ECN11761	8-14-03
K		E2	ECN12413	5-7-04	D			ECN11703	7-30-03
J		E2	ECN12314	3-24-04	C			ECN11529	5-2-03
H		E3	ECN12058	12-18-03	B			ECN11368	4-08-03
G		E4	ECN12015	12-03-03	A			ECN11321	1-30-03

NOTICE! THIS PRINT CONTAINS PROPRIETARY INFORMATION AND IS NOT TO BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF TWIN DISC, INCORPORATED RACINE, WI 53403 - USA
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MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT lbs / WR² N·m²

FIRST USE
ASSY.
MODEL MGX-5114A
NAME VALVE ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

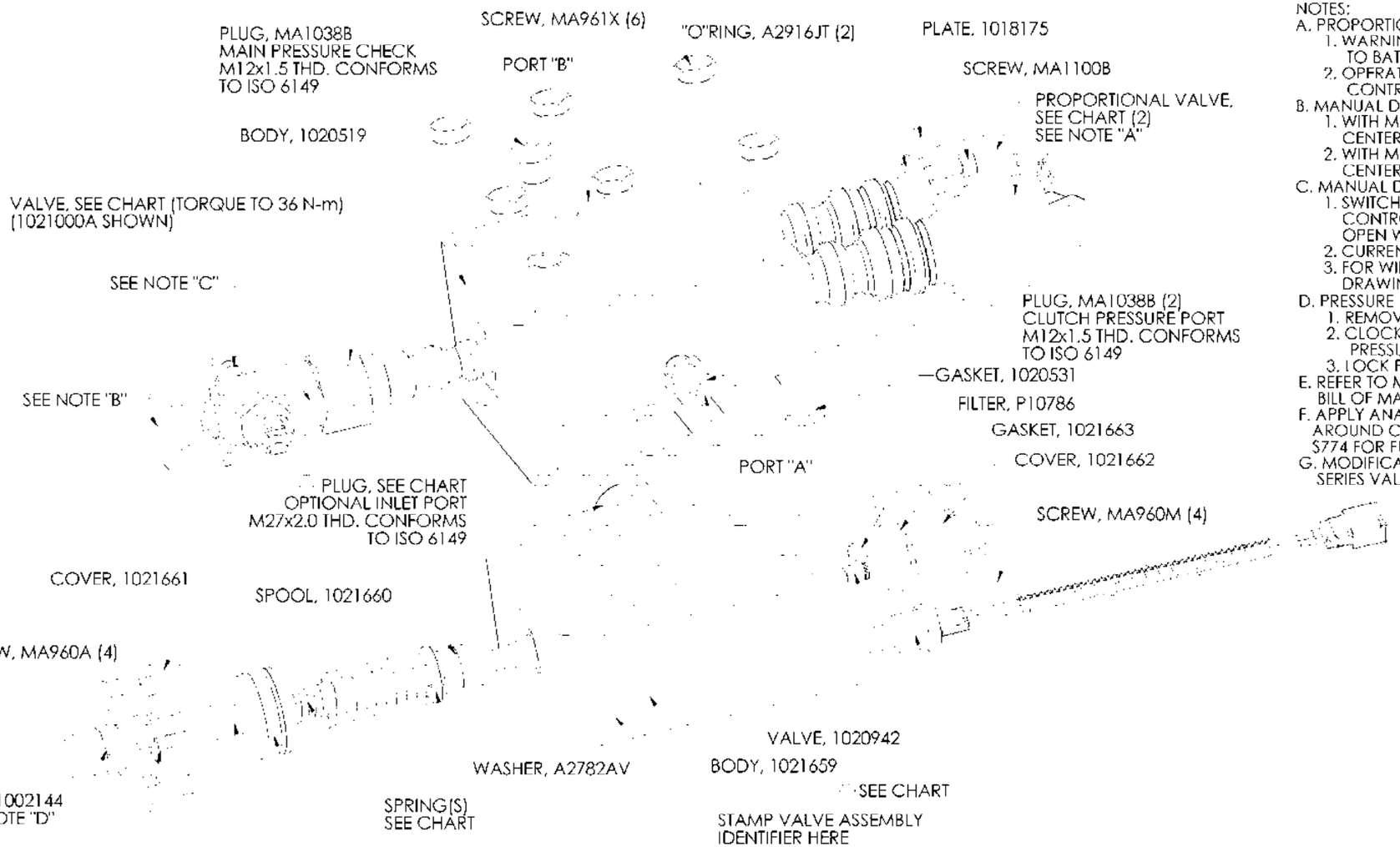
DATE 8-9-02
SCALE 1 : 1
DRN. D. MEYERS
CHK. ALC
APPD. GAM

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO 1020525

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1020729 SERIES

SHEET 1 OF 1 REV M



NOTES:

A. PROPORTIONAL CONTROL VALVE OPERATION.
   1. WARNING DO NOT CONNECT VALVE COIL DIRECTLY TO BATTERY/POWER SUPPLY VOLTAGE.
   2. OPERATION TO BE PERFORMED WITH ONLY TWIN DISC CONTROL SYSTEMS OR MODULES.

B. MANUAL DIRECTIONAL CONTROL VALVE OPERATION.
   1. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PUSH TO ENGAGE PORT "A".
   2. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PULL TO ENGAGE PORT "B".

C. MANUAL DIRECTIONAL CONTROL VALVE MODE SWITCH.
   1. SWITCH IS NORMALLY CLOSED WHEN MANUAL DIRECTIONAL CONTROL VALVE IS IN THE CENTERED POSITION AND OPEN WHEN LEVER IS ACTUATED FROM CENTERED POSITION.
   2. CURRENT = 20 AMPS MAX.
   3. FOR WIRING SCHEMATIC, REFER TO CONTROL MODULE DRAWING.

D. PRESSURE REGULATOR ADJUSTMENT.
   1. REMOVE 1002144 CAP AND LOOSEN 1002145 NUT.
   2. CLOCKWISE ROTATION OF 1020939A PISTON INCREASES PRESSURE. COUNTER CLOCKWISE DECREASES PRESSURE.
   3. LOCK PISTON IN PLACE USING JAM NUT AND REPLACE CAP.

E. REFER TO MARINE TRANSMISSION ASSEMBLY DRAWING OR BILL OF MATERIAL FOR VALVE MOUNTING AND SCREWS.

F. APPLY ANAEROBIC SEALANT MEETING M2828 REQUIREMENTS AROUND CORE PLUG, JUST BEFORE FINAL ASSEMBLY. REFER TO S774 FOR FURTHER INFORMATION.

G. MODIFICATION KIT TO UPGRADE EXISTING 1020729/1020696 SERIES VALVE ASSEMBLIES TO 1021658 SERIES VALVE ASSEMBLY.

VALVE ASSEMBLY PART NO.	VALVE ASSEMBLY IDENTIFIER	BOM	PRESSURE kPa (psi)	SPRING(S)	VALVE	SENSOR	PLUG	PLUG	CORE PLUG SEE NOTE "F"	PROPORTIONAL VALVE	MODIFICATION KIT SEE NOTE "G"
1021658A	A	43110	1795-2205 (260-320)	2013412C 2013412D	1021000A	NONE	M2051S	MA1038E	NONE	1020520	K1417
1021658B	B	43111	1585-1795 (230-260)	2013412C	1021000A	NONE	M2051S	MA1038E	NONE	1018528	K1418
1021658C	C	43112	2205-2760 (320-400)	2013412C 2013412E	1021000A	NONE	M2051S	MA1038E	NONE	1020520	K1420
1021658D	D	43195	1795-2205 (260-320)	2013412C 2013412D	1021000A	1016122A	NONE	MA1038E	NONE	1020520	K1417
1021658E	E	43196	1585-1795 (230-260)	2013412C	1021000A	1016122A	NONE	MA1038E	NONE	1018528	K1418
1021658F	F	43197	2205-2760 (320-400)	2013412C 2013412E	1021000A	1016122A	NONE	MA1038E	NONE	1020520	K1420
1021658G	G	43198	1585-1795 (230-260)	2013412C	1020542	NONE	M2051S	MA1038E	W/SEAT PORT "A"	1018528	K1419
1021658H	H	43199	1585-1795 (230-260)	2013412C	1021000A	NONE	M2051S	MA1185A	NONE	1018528	K1418
1021658J	J	43200	1585-1795 (230-260)	2013412C	1020542	NONE	M2051S	MA1053Q	NONE	1018528	K1418

REV	DESCRIPTION	DATE	APPROVED
B	A2 ECN12561	7-28-04	
A	B3 ECN12537	6-28-04	

DRAWN 1020391
MODEL MC 5222DC
TWIN DISC INCORPORATED

METRIC

VALVE ASS'Y.

5-04-04
FULL
MILLIMETERS
AIC
WITW A1

TWIN DISC
RACINE, WISCONSIN, USA

1021658

B

#1021629 04/05

TWIN DISC, INCORPORATED RACINE, WISCONSIN 53403, U.S.A. 262-638-4000/262-638-4482 (FAX) WWW.TWINDISC.COM